AMERICAN MACHINIST

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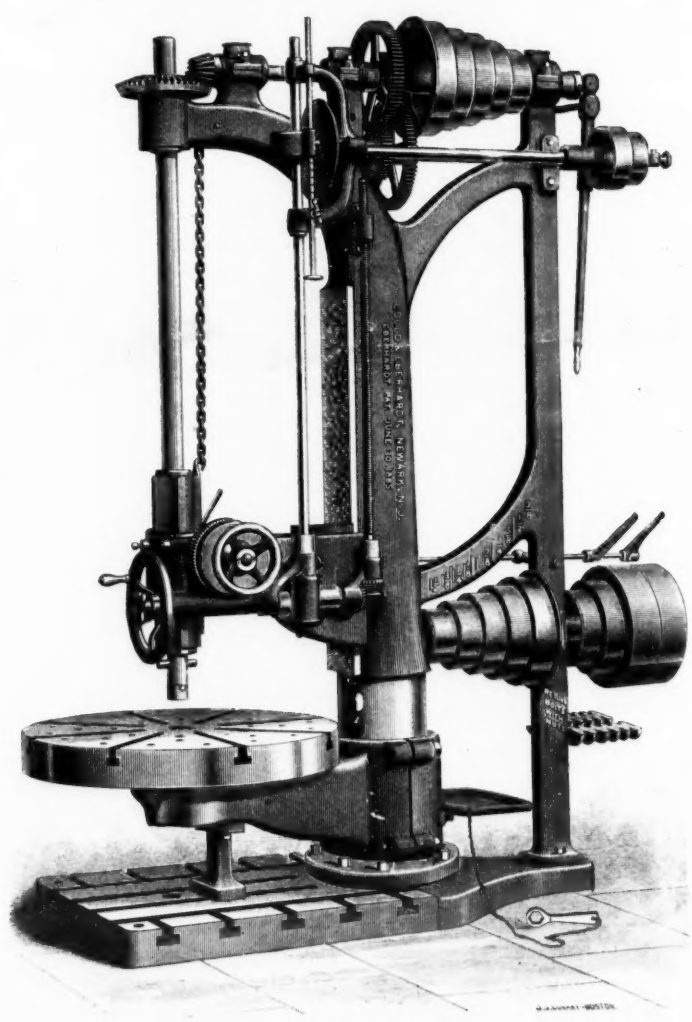
Eberhardt's Drill Press.

With this we present a perspective and (on page 2) sectional views showing the latest construction of Eberhardt's patent drill press. Since this press was described in our columns (June 13th, 1885,) it has been still further improved, notably by the addition of an automatic feed to the sliding head, by means of which, in addition to the usual feed applied directly to the spindle, it can be fed either up or down through its entire range of vertical movement. This feature we think will be appreciated, and for many kinds of boring jobs will undoubtedly be of great advantage. This feed is accomplished in a very simple manner, as shown in the sectional view, Fig. 2. The pinion *a* has a square hole through it, and to this hole is fitted a square plunger bolt, which may be shoved through the pinion into a square hole which is in the end of the friction device of the regular feed. The pinion being thus driven from the regular feed motion, it in turn drives the vertical feed motion screw.

Changes in the rate of feed are effected by moving the small friction disk up or down upon the vertical worm shaft, the rod by which this movement is effected being graduated so that the disk may readily be placed in the proper position for any kind of work.

The method by which the back gear is thrown in or out of action by a single movement of a lever is also shown. The cone pulley runs loose upon the shaft, and at its back end is a clutch, one part of which is fixed to the cone and the other is extended to form a sleeve which extends through the box, and is engaged or disengaged by the movement of the lever as shown. There is a feather by means of which this sleeve drives the shaft. The other shaft, upon which the back gears are keyed, slides in its bearings so as to connect its gears with the others—a movement which is effected by the same motion of the lever which connects or disconnects the clutch. A shelf is provided upon which to keep wrenches, tools, etc., and there is also a rack in which to hang bolts so that they may be found when wanted, instead of kicking about on the floor.

The other features of this press were fully described in our issue mentioned above, making further description at this time unnecessary. The presses are made by Gould & Eberhardt, Newark, N. J.



EBERHARDT'S DRILL PRESS.

Compound Locomotives.

BY PROF. A. T. WOODS.

It is reported that there are about 200 compound locomotives in use on English railroads alone, and that new engines there and on several European railroads are, very many of them, compound. That they are considered a success is shown by their continued use and construction. In this country we have scarcely begun to experiment, but two compound locomotives having been built so far as known to the writer. The most common type in England is the Webb compound, having two high pressure outside connected cylinders, which exhaust into one low pressure inside connected cylinder. It is clear that this arrangement would necessitate a wide departure from the existing types of American locomotives. Another arrangement has but two cylinders placed in the usual manner. This is an awkward design at best, and does not appear to be practicable for large engines, on account of the size of the low pressure cylinder. A third arrangement has two cylinders on each side arranged one in front of the other, or "tandem." It would seem that this system is the most feasible for American locomotives, and is that adopted for the two American compound engines previously mentioned. One of these was abandoned as a compound after a few months' trial, as it did not prove to be economical. The other, which has been recently mentioned in the AMERICAN MACHINIST, is now on trial.

As this type offers obvious practical advantages as compared with the other forms of compound locomotives, it is proposed to point out in this article some of the special problems which it presents, and to compare its probable consumption of steam with that of the ordinary locomotive. In order to start with a clear understanding of the case, we will briefly outline the action of steam in such an engine.

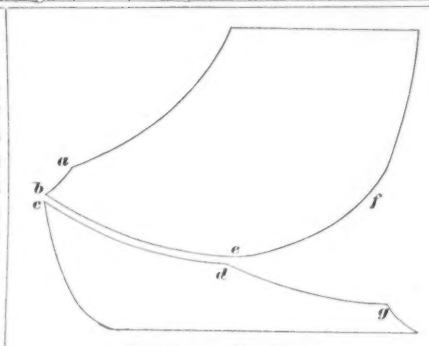
The figure (page 2) represents approximately the theoretical indicator diagrams from a tandem locomotive. The diagrams are shown as they would be traced by the indicator, the upper card being from the high pressure and the lower from the low pressure cylinder. The scales of pressures are the same, and the diagrams are placed together so as to show the action of the same initial volume of steam successively in the two cylinders. For illustration, a cut off at $\frac{1}{2}$ stroke in each cylinder is taken. The admission and expansion lines of the high pressure card show no special features. Release occurs at *a* and connection is opened between the high pressure cylinder and the passage connecting the cylinders, which we will term the receiver. As the receiver pressure is lower than that at *a* the pressure drops to *b* and still further to *c* when the low pressure valve opens. The curve from *c* to the point of low pressure cut off *d* represents the expansion of the steam which filled the receiver and high pressure cylinder until it fills half the low pressure, the receiver, and half the high pressure. The remainder of the low pressure diagram from the point of cut-off *d* is similar to that of a simple engine. The back pressure line of the high pressure card from *b* to *e* is nearly parallel to and a little above the corresponding line of the low pressure, the difference in pressure being due to friction in the ports. After cut-off occurs in the low pressure cylinder the steam in the receiver and high pressure cylinder is compressed before the high pressure piston until the point *f* is reached, where the high pressure exhaust closes. From this point further compression occurs in the high pressure cylinder to the end of the stroke, or until steam from the boiler is again admitted. It will be seen that the pressure at *f* is that of the steam in the receiver with which the next exhaust from the high pressure cylinder mixes. Two points of difficulty in the compound locomotive, as compared with the ordinary compound engine, now become apparent. These are the early release and the early compression, both of which seem to be the necessary result of the high piston speed. It is evident from the diagrams that the volume of steam which is admitted to the high pressure cylinder from the boiler at each stroke is expanded until it finally fills the low pressure cylinder. The total number of expansions is then very nearly the volume of the low pressure divided by that fraction of the high pressure cylinder which is filled from the boiler at each stroke, and this also equals the initial pressure in the high pressure cylinder divided by the final pressure in the low pressure cylinder.

For purposes of illustration, we will now assume the data for a practicable case and give an outline of the methods employed, and the results. In locomotives, not over 90 per cent. of the boiler pressure is realized as initial pressure in the cylinders. Therefore, with a boiler gauge pressure of 160 pounds, the initial pressure will be about 144 pounds by gauge, or 158.7 pounds absolute. If this could be expanded down to 2 pounds above the atmospheric pressure, we would obtain about 9.5 expansions. But practically, this number cannot be obtained, owing to the drop between cylinders, wire drawing, etc., and for our present purpose 7.5 will be assumed. A common practice is to allow the same degree of expansion in each cylinder, and on this basis the ratio of the two cylinders will be $\sqrt{7.5} = 2.74$, which will also be the actual ratio of expansion in the high pressure cylinder. With 24 inches stroke, this will be obtained by cutting off at about $7\frac{3}{4}$ inches, allowing 8 per cent. clearance. The ratio of the cylinder volumes will be taken as 2.7 to 1, and as the stroke is the same, this will also be the ratio of their piston areas. Suppose now, that we wish to find the dimensions, with the data as given, for a compound locomotive which is to do the work of an 18×24 simple engine, and assume that at its earliest cut-off, $7\frac{3}{4}$ inches, it is to give a mean effective pressure equal to 60 pounds in the 18×24. We estimate the volume of the receiver to be .15 of that of the low pressure cylinder, and for the present calculation assume that the high pressure cylinder is fitted with an independent cut-off or other valve gear which will enable us to follow to 18 inches in the low pressure when cutting off at $7\frac{3}{4}$ inches in the high pressure, and to have the exhaust close as late as 21 inches. An examination of locomotive indicator cards shows that the actual mean forward pressure cannot be safely estimated at over 90 per cent. of the theoretical, and that allowance is made in the calculations.

Following through the several expansions and compressions, using the usual formulæ and making the above allowances in the calculated results, we find the mean effective pressures in the high and low pressure cylinders to be respectively 47 and 18 pounds. To determine the actual sizes of the cylinders we have the relations: low pressure area $= 2.7 \times$ high pressure area, and $47 \times$ high pressure area $+ 18 \times$ low pressure area $=$

60 × area of 18 inches diameter. From these we find the high pressure area = 159.7 square inches, and the low pressure area = 431.1 square inches. The corresponding diameters are $14\frac{1}{4}$ + and $23\frac{1}{2}$—. On the basis of the same boiler pressure and with the same allowances, the 18 × 24 engine would give 60 pounds mean effective pressure when cutting off at about 5 inches. The volume of 5 inches of the 18 inch cylinder is nearly equal to that of $7\frac{3}{4}$ inches of the $14\frac{1}{4}$ inch cylinder, and therefore the volume of steam drawn from the boiler at each stroke is nearly the same for the two engines, no allowance being made for condensation. But if we calculate in the same manner the volumes of steam used for the same work at later points of cut-off, we find that the results are more favorable for the compound, the relative consumption decreasing until at 18 inches cut-off in the high pressure, corresponding in work to about $15\frac{1}{2}$ inches in the simple engine, the compound uses but 64 per cent. as much steam as the simple engine.

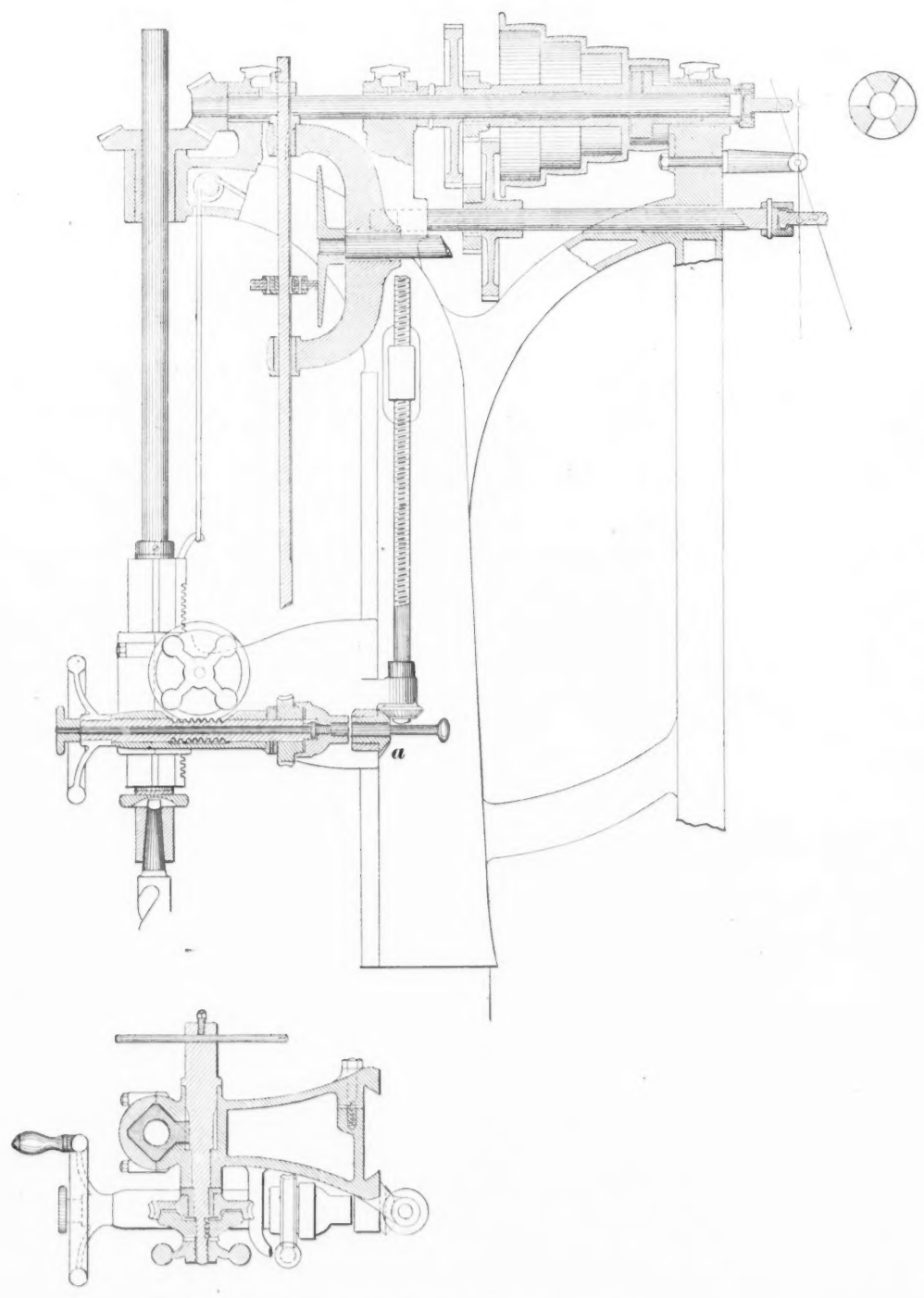
It thus appears that in regard to the space to be filled with steam at each stroke for the same work, the compound locomotive is the more economical at all points except the earliest cut-off, and at this point there is little difference between the two engines. The question of initial condensation and re-evaporation is of great importance, and unfortunately we cannot estimate the relative amounts with any certainty. But the results of comparative experiments on simple and compound stationary engines lead us toward the conclusion that, if the cylinders and receiver of the compound engine are simply lagged as usual, the loss from condensation will be somewhat greater in the compound than in the simple engine. This difficulty may probably be overcome by placing a large portion of the receiver in the smoke-box and thus superheating, and it will be easier to superheat steam at the receiver pressure than at the boiler pressure. It will be noticed, that at $7\frac{3}{4}$ inches cut off in the high pressure, the work done by the two cylinders of the compound is very nearly equal, as it should be with the assumed proportions, but as the high pressure cut-off becomes later the low pressure cylinder does an increasing share of the work. This is of comparatively little importance in this type of engine, since the two pistons are attached to the same rod. As the difference in area of the two pistons is greater than that of the simple engine, the starting power of the compound is the greater. By means of a non-return valve in the receiver passage, this advantage can be largely increased. An increase in the volume of the receiver will produce little effect on this engine while running, but it will increase the dead space to be filled with steam in starting.



COMPOUND DIAGRAM.

We will now consider the action of a compound locomotive having the ordinary link motion, without independent cut-off or separate steam and exhaust valves. Taking the dimensions of cylinders as calculated, we find that when cutting off at 12 inches, the power developed will equal that of the simple engine at about 7 inches cut-off, and that the steam consumption of the compound at this point exceeds that of the simple engine. At 14 inches cut-off in the compound, equal to about 10 inches in the simple engine, the compound is the more economical of the two as it is for later points of cut-off. The reason for this difference in the two compound engines is to be found in the excessive compression in the high pressure cylinder in the latter case. When cutting off at 12 inches, compression begins at about $19\frac{3}{4}$ inches with a valve without inside lap, and with a back pressure of 75 lbs. absolute, when the high pressure exhaust closes, the clearance space would be filled with steam at about 240 lbs. pressure at the end of the stroke. This difficulty of course increases as the cut-off becomes earlier, so that the prospects of success with this form of valve gear are not good. But it would seem that with any form of valve gear which has a greater range of adjustability, the probable economy of this type of a compound locomotive would be sufficient in many cases to justify careful experiment.

It is evident that there are special difficulties to be overcome in applying the compound principle to locomotives, and that the design must be made with great care if we would obtain satisfactory results. But while the change from simple to compound would probably pay in many instances, there are cases in which the simple engine is better.



EBERHARDT'S DRILL PRESS—SEE PAGE 1.

Coal Dust as an Explosive.

Professor Arnold Lupton recently delivered a lecture in the Philosophical Hall, Leeds, his subject being, "Coal Dust a Cause of Explosions, and How to Lay It." The professor alluded to the effect of preconceptions in delaying the discovery of the true causes of phenomena. In the case of colliery explosions, it had been taken for granted that fire-damp or marsh gas was the cause, and the eyes of engineers had been closed to every other cause. To Mr. William Galloway, who in 1876 held the position of inspector of mines, he gave the chief credit of the discovery that coal dust was the prime agent of destruction in coal-mine explosions. The Royal Accident Commission, Professor Abel, the Prussian Fire-Damp Commission, and others, had made experiments, all going to show that very fine coal dust when stirred up with air, was explosive, and also coal dust not so fine was explosive in an atmosphere containing only one per cent. of gas; a percentage too small to be detected by the ordinary methods. He said that with the knowledge now gained, it was easy to understand disasters that were incomprehensible on the assumption that fire damp was the cause. In conclusion, it was stated that several results were now plain—first, that coal dust was as dangerous as fire-damp or loose gun powder; second, that coal dust could, by means of high-pressure water jets, compressed air water jets, and other means, be laid easily, cheaply and with economical effects, and that as a result of this, not only would the death rate from colliery explosions be reduced 75 per cent., but the health and comfort of the miners would be much improved.

English Boiler Inspection.

BY W. H. BOOTH.

THIRD PAPER.

We may now well draw attention to some of the faults in construction and maintenance which have been discovered as a result of years of accumulated evidence and observation, and we have the less hesitation in doing this, because we are still so frequently brought into contact with bad designs that are only to be explained by ignorance on the part of the designer of the facts taught by thoughtful inspection. To this day, in spite of the utmost care that is now exercised in order to avoid it, the fault which still frequently is earliest to develop in a Lancashire boiler is grooving or channeling of the front end plate or of the angle irons connecting the end plate and furnaces, and similarly, but to a less and more infrequent extent, of the back end plate and angle iron connections. In the early days of inspection this fault was so frequently noted that a cause was soon sought. Then, as now, the grooving was always found to commence opposite the ends of a gusset stay or just below a longitudinal bar stay, evidently pointing to some connection between the grooving and the presence of the stay. Thus, Fig. 1 may be taken to represent the inside view of an old style boiler end plate about the furnace connections. The gusset stays as shown were brought close down to the furnace angle iron, in the belief that the end plate required to be firmly held; consequently, when a fire was burning in the furnace and the crowns of the furnaces expanded to a greater extent than the shell, the end plates would be pushed outwards at the crown; but as they were held fast by the gusset to within three inches of the ring of furnace rivets, it is clear that all the expansion of the furnaces had to be accommodated by this short three inches of plate, and further, all movements due to slight vibration of the furnace tubes, which is caused by ebullition, had to be taken up by this short space. Now the expansion of a furnace crown in a modern boiler at 70 pounds pressure is about $\frac{3}{8}$ inch more than that of the shell in a length of 28 feet. Though less in an older boiler, at low pressure, and not so severely worked, it must still have been quite considerable, and it is evident that, such being the case, that portion of the front end plate between the lowest rivet of the gusset angle irons and the furnace rivets would be severely strained by repeated bending back and forth. Clearly the most severe action would occur at the ends of the gusset angle irons and upon the edge of the furnace angle irons, and the result, as shown to a larger scale in Fig. 2 in section, was the grooving spoken of, and it was early recognized that this curious action was due to combined mechanical and chemical action—mechanical, because the

plate was sharply bent or nipped across the stiff edges of the angle irons, and chemical, because the corrosive action of the water was potent to dissolve the iron just at the point of minimum bending strain, as its fiber or grain would be open at that point.

This action was sometimes very rapid, especially with acid waters. In a boiler found thus affected, the custom has been to cut away some of the lower rivets passing through the gusset plates and their connecting angle irons, in order to increase the length of plate known as the breathing space from 2 or 3 inches up to 6 or 7. In new boilers constructed under supervision or to the inspector's recommendations, the gussets were kept shorter and 7 inches were allowed for breathing space. Further experience demonstrated the benefit of this change, which, however, as pressures increased, was found insufficient, and it was increased to 8 inches, and later to 9 inches, but has now grown to 10 inches, at which it now stands for pressures of 100 pounds, and the capacity of the unsupported 10 inches of flat plate to withstand 100 pounds is proved and the grooving prevented or reduced. Though not general, we believe that it is the habit of some boiler makers to construct their furnace tubes about $\frac{3}{8}$ inch shorter than the length between boiler end plates when cold. This should be chiefly at the crown of the furnace, and to be correct should taper off until at the lower part the tube is as long as the boiler shell. The result of this shortness is that when riveted up the end plates are drawn in a little, so that when under steam and the furnace crown has expanded, the end plate may come out just about the amount it has been drawn in, and so be under no mechanical stress at all beyond that of the steam pressure. The advantage of this is obvious; for the plate, when at work, is in its normal unstrained condition, and is not exposed so much to the same molecular disintegrations as when both furnace and barrel are of equal length, cold. By some engineers, however, the grooving was thought to be due to too weak end plates, and hence these were thickened up to as much as $\frac{3}{4}$ and even $\frac{7}{8}$ of an inch; but the fault was even more apparent in the thick plates, and not only so, but the straining of the ring seams of the furnaces was still more marked than before, and often very severe leakage developed at those seams, due simply to the one simple cause, overstaying. It is now the practice to make end plates about $\frac{1}{8}$" thicker than shell plates only, so that a $\frac{7}{16}$" boiler would not have end plates more than half an inch thick, and a modern 8 foot boiler with $\frac{1}{2}$ inch steel shell will have a $\frac{9}{16}$", or at most $\frac{5}{8}$" end plate.

This fault of grooving is to be found not merely at end plate gussets, but also on the end plates between the furnace and shell sides where the water space is about 5 inches; and here again the same causes operate. As a preventive of this the same or similar steps require to be taken. A favorite connection of the end plates and shell was by an internal angle iron, as in Fig. 3, and this left but very little space *a* between the shell and furnace angle iron rivets down in the side water spaces. The remedy for this defect was clearly an increase of the space *a*, and could be only effected by placing the angle iron outside, as in Fig. 4, very much increasing *a*, and effectually stopping the corrosive channeling, to which there is less tendency, of course, down the furnace sides than over the more highly heated crowns, and the breathing space secured by the reversal of the angle iron is found to be all that is necessary. Everything we have said of the front end plate applies to a modified and less degree to the back end also, which is subject to the same faults in a lesser degree and amenable to the same remedial principles. The breathing space is kept the same—10 inches—and though an inside angle iron is still universally used to connect the shell and back end plates, the distance *a* is kept sufficient in amount by another means—the ends of the furnace tubes are reduced in diameter considerably between that of the furnace, and so admit of the inside angle iron and still allow a sufficient breathing space *a*. These various points will all appear in our illustration of the Lancashire boiler. Though the end plates have filled up the whole of this paper, no apology is required, for the design of this part of the boiler is the most important of any, and it has been truly remarked, "Show me the end plate and I will tell you my opinion of the boiler and its designer."

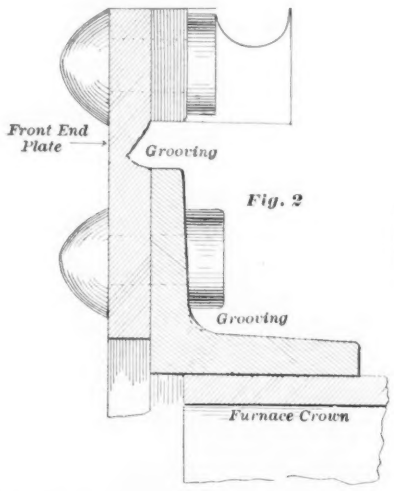


Fig. 2

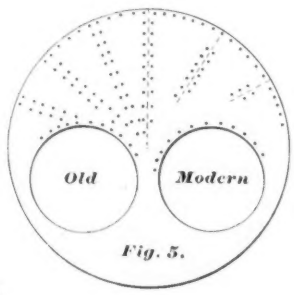


Fig. 5.

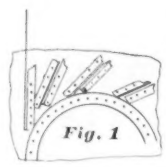


Fig. 1

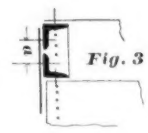


Fig. 3

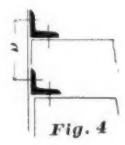


Fig. 4

Of the disposition of the gussets we must defer speaking until later, merely remarking that, in common with end plates, generally, the gusset spacing exercises an important influence upon the enduring qualities of a boiler. Fig. 5 shows roughly the difference between the old and modern end plate.

They seem to be having some trouble about boiler inspection and insurance in England, and complaint is made that the system of boiler insurance is simply a system of purchasing indulgences; that some of the insurance companies simply receive the fees and do not make proper inspections; while at the same time they relieve boiler owners of all risk by paying compensation in case of accident. Some of the English legislators seem to favor examining and issuing certificates to men in charge of boilers, while others favor examining and giving the certificate to the boiler. We think that legislation on this question, to be practical and effective in protecting human life and property, should seek to enforce the construction of none but first-class boilers, and then, what is of equal importance, require them to be placed in the hands of men who understand the care and management of boilers. Good men placed in charge cannot make poor boilers safe, and the best boilers are made unsafe by being placed in the hands of ignorant and careless men.

A New Foot Press.

The accompanying illustration represents a small foot press, a recent production of the Ferracute Machine Company, of Bridgeton, New Jersey. It belongs to the class of swinging lever or "pendulum" presses, and is adapted for a large variety of light sheet metal work, such as punching small holes of any shape, eyelets, tin washers for felt roofing, jewelry, etc., etc. It is peculiarly adapted for the caps or "studs" for fruit cans, making even larger sizes with ease.

The adjustable stop shown at the top of the press enables the operator to regulate the shut height of the dies with great accuracy. Die clamps are provided, the bolt heads being secured in tee slots in the bed, enabling them to grip die-plates of any diameter up to 8 inches. The treadle or pendulum is quite heavy, especially at its lower end, its momentum materially assisting the operation. A rubber bumper is set in back of press-frame, against which the treadle strikes on its return stroke, obviating the banging noise sometimes noticeable in presses of this kind. An iron pan is inside of the pedestal, near the top, to catch punchings or work of a "push through" nature. The pedestal contains an opening of ample size for the purpose required. The press is easily detached from the pedestal, and can be used as a bench press if desired.

NEW FOOT PRESS.

The stroke is $1\frac{1}{2}$" when the stop is in its highest position; height from bed to slide-bar (when up) is 5"; diameter of round hole in bed, 3"; total weight, 275 pounds.

We have heard, lately, of more than the usual number of boilers being destroyed or seriously injured by using spring or well water. To the eye such water may be remarkably pure, and it may be pleasant to the taste; still it may contain foreign matter that will speedily destroy a boiler. The only sure way in cases where it is proposed to use water from a well or spring is to have it analyzed by some competent chemist, who will give the probable results of using it. In some cases he may decide that it should not be used under any conditions; in others he may suggest a way for safely using it.

Many people think Frenchified words must go, especially in view of the rage to be "English, you know," so conspicuously visible in New York. On this basis an effort is being made to re-christen a certain caravansary on Forty-second street in this city. Instead of Grand Central Depot, it is proposed to call it the Grand Central Depew.

Pulley Coverings.

The slipping of belts is an annoyance which is frequently experienced by users of leather and other belting employed for the transmission of power. Various methods are adopted in order to remedy this evil, such as increasing the tension and friction by tightening up the belts and by making them adhere to the pulleys by means of sticky compounds. Both of these remedies are in many instances fairly effective, but, on the other hand, they are open to somewhat serious objection. The former method very materially increases the pressure, and consequently the friction on the shaft journals, while the latter absorbs a great deal of power in overcoming the adhesion of the belt as it leaves the pulley in a tangential direction. Thus it is clear that neither of the above methods is satisfactory; but, in order to obviate these difficulties, Messrs. Wilkinson & Co., of 1 Hopwood avenue, Manchester, apply a perforated covering to the face of the pulley. This covering consists of perforated sheet-iron about $\frac{1}{16}$ in. thick, which is secured to the pulley by rivets. The tension on the belt causes it to slightly sink into the holes, and thus gives the belt a better bite on the pulley with considerably less tension than is required for an ordinary smooth-faced pulley. Again, it is very probable that a fast-running belt carries in a film of air between it and the surface of the pulley, so that the belt partially floats on a cushion of air, and hence has a great tendency to slip. By adopting a perforated covering the air manages to escape through the holes and prevents this action taking place. The covering also serves the useful purpose of strengthening the rims; in fact, it is frequently used for repairing cracked and broken pulleys.

An ingenious device is shown at the Manchester Exhibition for illustrating the superiority of the grip when this covering is used. Two pulleys of the same size are keyed to a shaft, one being plain and the other covered with patent covering; each one is provided with an ordinary leather belt, which is fastened to the floor at one end and weighted with equal weights at the other, to give the same tension in each. The twisting moment required to produce slipping in each case is measured by a horizontal arm attached to the shaft, on which a sliding weight is moved along until slipping begins. We tried this experiment for ourselves, and found in every case that the covered pulley would stand nearly twice the twisting moment that the uncovered pulley would. These coverings can be applied to existing pulleys without removal from the shaft; the cost is, also, very trifling.—*Engineering.*

One of the notable exhibits at the Manchester, England, Exhibition, is that of Worthington pumps. One of these is a compound, with two 12 inch high pressure and two $18\frac{1}{2}$ inch low pressure cylinders. The performance of this pump working against high pressure is highly spoken of in English journals.

The *Northwestern Miller*, speaking of the trouble from water power at Minneapolis, says:

The trouble from poor power is repeated this week. Some of the water-mills are almost wholly cut off at times, while none without the adjunct of steam escape with a reduction in product of less than one-quarter to one-half. This is very annoying to millers, who are doing everything in their power to supply the calls of customers. The same twenty mills are running, and the quantity of flour being turned out is not much changed. Six engines still do duty, and another mill has arranged to put in steam. Empty cars are obtained in sufficient quantity without difficulty.

The *Locomotive* offers some good advice in regard to defective boiler tubes. Continual leakage around new tubes, where the boiler is clean and the water is good, generally indicates, it says, something wrong in material or workmanship. Severe expanding of the tubes splits the ends. When this is the case the boiler will always be tender at this point, with a tendency to leak badly.

Hinged Moulding Boxes.

BY S. BOLLAND.

Although to show the substitution of hinges for pins in moulding boxes is the primary object of this article, I was necessarily led into other important subjects in connection with their use. My experience has taught me, that in the majority of foundries all the ingenuity of the moulder is expended in devising methods that will enable him to mould nearly every large green sand casting in the floor. This is generally done with the view of saving cost of flasks, and when only one or two such castings are needed, I believe it is the correct thing to do. But other reasons are advanced for this almost universal bedding-in system; the foremost of which is, that it is the safest plan to adopt when the job to be made is one of great magnitude, and, while I partly admit the force of such a reason, yet, I am fully persuaded that much better results are assured by adopting a system which can be made equally safe, and at the same time enable the moulder to examine and finish all the parts of his mould with equal facility. It is well known that very many large jobs having critical parts are made in dry sand or loam, for no other reason than to secure a well-finished casting which could not result if it was made in green sand by the ordinary methods on account of the difficulty of reaching its remote parts. If such extra expense in the production of these castings can be saved it must surely be folly to persist in such a course.

Enter almost any foundry and examine such castings as we are speaking of, and the ugly fact of smooth upper surfaces, and equally rough and unsightly lower surfaces presents itself. To particularize, let it be an architectural works or a foundry making castings for tool and engine work, what do we find? As before stated, all the ingenuity possible has been expended to have castings made in the floor without separation of parts. Brackets are made in cores and rammed against the pattern, leaving in almost every case an unsightly mark, if not something worse; chipping faces and mouldings are pinned on loose, to be withdrawn after the pattern has left the sand, and as a natural consequence, portions of the face of the mould are disturbed and fall into the bottom, or worse still are forced away when the iron enters the mould and rise to the surface. And yet, inconsistent as it may seem, the greatest care is taken with the very small surface which can be reached by the moulder, to make that as smooth as tools and hands can make it; which, by the way, only shows up the deficiencies of those parts of the mould which cannot be reached, all the more by comparison. This is seen more particularly on square and rectangular columns—having two or more face sides with panels and other ornamentation—lathe beds, foundations for engines, etc.

Some firms desiring quality rather than quantity, partially overcome this difficulty by lifting out the sides of the mould—when practicable—on drawbacks, which are plates bedded alongside the pattern, and partings made where requisite. After the mould is rammed and the pattern taken out, then such portions of the mould as rest on the plates can be lifted away; but this method necessitates still more digging and ramming, and, of course, adds to the cost, whilst it is oftentimes but a sorry makeshift.

It is to facilitate the making of such castings that prompts me to suggest the use of hinges. Fig. 1 is a perspective view of the mould of an ordinary square column, the dimensions of which are 18″ x 18″ x 12 feet, with panels on three sides. I have shown the mould as cut across at the first hinge, so that the working parts can be seen. The cheeks are thrown back on the hinges *A*, the top flange resting on lugs *B*, exposing the core *C* its full length, as well as the bottom of the mould *D*. It will be plain to anyone having a knowledge of such matters, that all the parts of such a mould can be treated with the same care, the result being a casting equally perfect all over.

At Fig. 2 I have shown the necessary appliances for making castings by this method, and as this view is drawn isometrically, the whole details can be seen at a glance, much more readily than would be possible by the ordinary plan and elevation. Only a section of the sides is shown, but this is all that is needed for a clear understanding of the whole. I have selected a square column of the dimensions specified, because it is a class of work which is going on all the time, and serves well to illustrate the method suggested.

As I do not in this article propose to explain the details of moulding such a casting, I shall confine myself to the subject of hinges and the securing of the flask. The bottom flask *A* is shown longer than the cheeks, as it is supposed to be a fixture in a foundry exclusively engaged in this work. It is best to have such a bottom flask made with deep sides well down in the floor, and good stiff cross-bars bolted across; such a bottom flask serves to make ordinary columns, or beams and girders in, the cope of course being made to correspond with flange at *B*, to which it can be bolted or clamped, thus saving both time and expense of weighing down. It is on just such a flask that these sides rest. The lower half of hinge *C* into which the upper half works, serves the same purpose for the regular cope when the bottom is being used for ordinary work, but in this case when the checks are being used, the cope can be pinned or iron slides bolted on to fit the recess shown at *E*. At *F* is shown the lifting plates secured to the cheeks. These plates serve the double duty of stiffening the cheek as well as carrying the sand, and may, of course, be taken into consideration when the mould is being bound together. By referring to *G* it will be seen how the cheek is turned on its hinges, and without giving dimensions it will suffice to say that one or more of these lugs may be used, according to the length of the cheek, and also that they must be made with leverage sufficient to turn backward and forward easily. The lug shown at *H* is for binding purposes. Let as many of these be cast on the bottom flange, to correspond with similar ones on the cope, as may be considered necessary for effectually securing the mould when closed. Holes must be cast in these lugs large enough to admit a strong bar reaching from one to the other—as shown at Fig. 3—and wedged firmly between the bar and cheek. Sometimes it may not be required to use any ends to the job in hand; if so, bolt holes cast in the sides at each end can be utilized when the way is clear, for the bolt or provision can be made for bolting on loose ends as seen at *I*, Fig. 2.

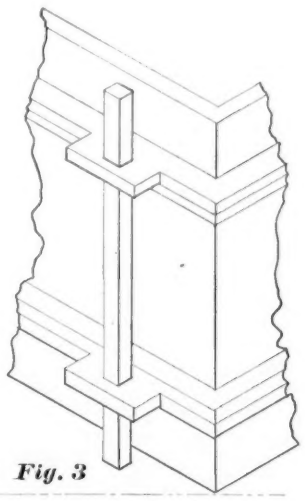


Fig. 3

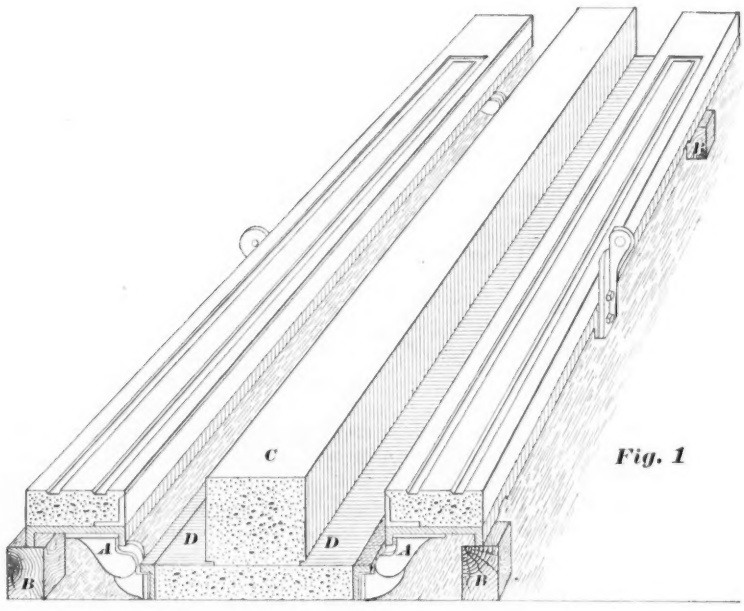


Fig. 1

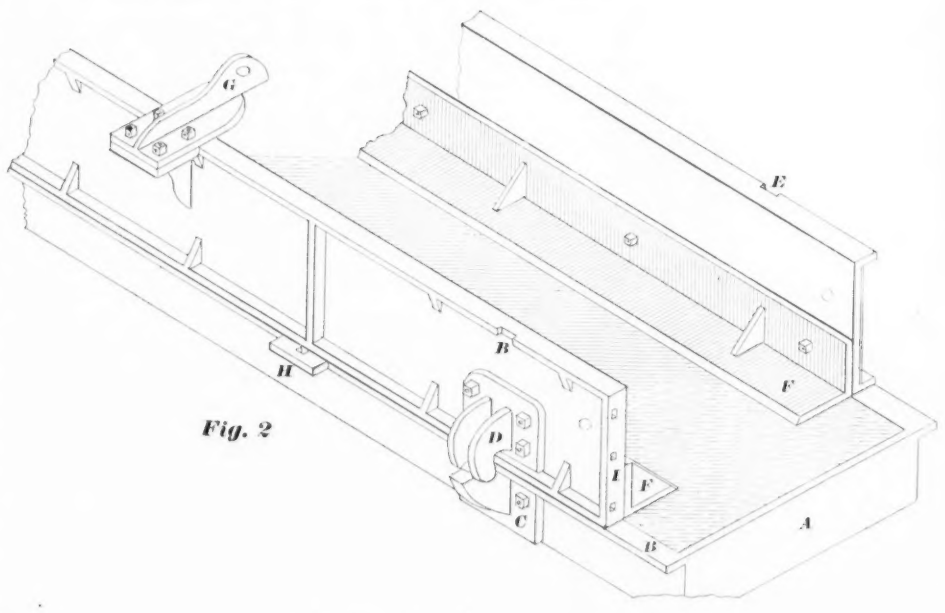


Fig. 2

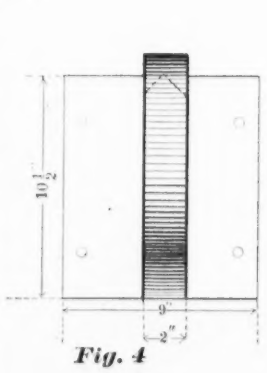


Fig. 4

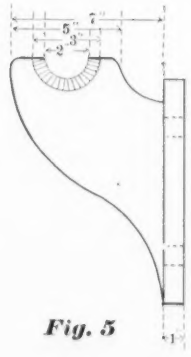


Fig. 5

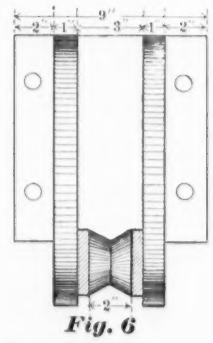


Fig. 6

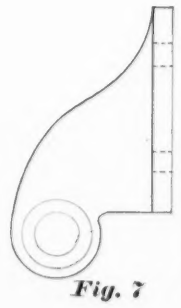


Fig. 7

HINGED MOULDING BOXES.

Should it be required to lift away the end as well as sides of the mould, this may readily be done by continuing one cheek round the ends to meet the other, or carry one-half on each, but if the job in hand be too unwieldy for such a method, as for instance, tanks, hot wells, cisterns, etc., of large dimensions, then, of course, separate cheeks can be made and turned back on their own hinges. To bind such ends provision can be made to bolt them to the cheeks when they are turned into place, or they can be treated the same as directed for the cheeks.

At Figs. 4, 5, 6 and 7, I have shown front and side elevations of both halves of a hinge suitable for the job described, with figured dimensions. This hinge is certainly the best as well as the cheapest that can be made, requiring no machinist work on it whatever; it is ready for use as soon as it leaves the sand. It is an absolute fit, cannot get out of order, and must, therefore, commend itself, especially to foundries having no machine shop. In conclusion, a hinge like this can be almost universally applied on ordinary work where the lifts are not too deep, or the parts of the mould too high to clear, as it closes on the circle. It will save considerable to a firm using large numbers of top and bottom flasks.

Ethics in a Machine Shop.

BY JARNO.

III.

Is a man responsible for following a defective drawing? We will now consider this question more definitely than in Article II.

I have a few times heard men say that they would obey orders if they knew them to be wrong, but I have not heard this expression for some years. There should be no question in this matter, and the man who will not at least call attention to a defective order, when he sees the defect, is no longer tolerated in a successful establishment. The aspect of the question that I wish especially to consider may be put in the limited form, "Is a man responsible for not *discovering* mistakes?"

Some years ago, while making a safety valve, this question was first brought to my attention. As in Fig. 4 (page 5), the drawing called for the lever guide *A* to be simply driven in and held only by the fit or by friction. The lever holder *B* was shown threaded. After the guide *A* had been fitted in, the mechanical superintendent learned that it was not threaded. He expressed his surprise and disappointment and remarked that I could not have followed the drawing. Upon learning that I had followed the drawing he was surprised that I should have done so.

He stated that a machinist ought to use his judgment in following a drawing, the same as he would about his work. The foreman said he supposed I knew that the guide ought to be threaded. A shop mate of longer experience, asserted that it was an omission that he would have noticed and that he should have threaded the piece.

Both the foreman and the shop mate may have been wise after the event. Some men carry a heavy pressure of pent-up surprise that is relieved when others make mistakes. I at first felt that I was not, ethically, subject to any criticism whatever, but after making all allowance for the after the-event wisdom of the foreman and the shop mate, I concluded that there was a recognized principle subjecting to censure a machinist who follows a defective drawing.

Admitting that the superintendent was right in his criticism, what shall we say of his duty with drawings received by his establishment? When a new tool is received at a machine shop, from an other establishment, this tool is generally examined for defects. I have one shop in mind where no bill for any machine is audited nor any money paid until the machine has been critically examined. At this shop, also, a drawing is examined before commencing on work ordered.

If shop ethics allows us to inspect a machine before accepting it, to protect ourselves against defects through the maker's mistake, then we should be required to examine drawings to also protect our customer against his mistakes. If we have mechanical ability that enables us to judge of the products of others, our customers have a right to expect us to exercise this ability in their interest.

After the recipient has carefully examined a drawing, the responsibility for its defects must rest largely with the customer; yet it is doubtful if even then he should pay wholly for losses incurred in following a drawing so palpably wrong as Fig. 3.

Admitting that there are cases where it is difficult to decide whether the machine maker or the customer should bear losses from mistakes in drawings and specifications, it would appear that there may be cases where the responsibility rests upon both parties and the losses should be shared by each. It can hardly be assumed as fundamental that a loss must alway be met by some one party only, and not lightened by the other party.

An illustration of a somewhat similar line of thought may help us in the one we are considering.

In Fig. 5, let the weight *W* be acted upon at the same time by two ropes, one rope continuously pulling in a direction parallel to the arrow *A*, and the other rope continuously pulling in a direction parallel to *B*. Now we cannot, for any appreciable time, consider what has been the effect of the action of rope *A* upon the weight *W*, without at once thinking of what, during the same time, has been the effect of the action of rope *B*. In thought we cannot for an instant separate the actions of the two ropes. If it were possible to do this, we would think of the weight as following alternately the ropes *A* and *B*, in a zigzag path. It is evident that the weight will not follow directly either the rope *A* or the rope *B*, but will move in the direction of arrow *C*, somewhere between *A* and *B*. If *A* moves faster than *B*, the path *C* of the weight *W* will be nearer parallel to *A* than to *B*, yet always both ropes have to do with the movements of the weight.

Some modification of this problem runs through all nature—nothing is ever acted upon by less than two forces. I think the same law runs through the lives of men. The acts of each man influence those about him in some direction. In some degree, every man is responsible for the status of the community in which he moves. There is possible no isolation. The machinist who, out of the shop, misspends his time and in the shop tells how successful he has been in so doing, interferes with the success of the shop, and lowers the tone of the community. I have heard an employe of a successful establishment assert that:

"No small part of the success of this concern is due to its foremen and its workmen." If this is correct ethics, then no small part of any concern's failures may be due to its foremen and workmen.

If the result of a piece of work is in the wrong direction from a defective drawing, it was because the drawing was made

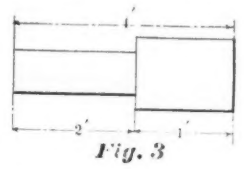


Fig. 3

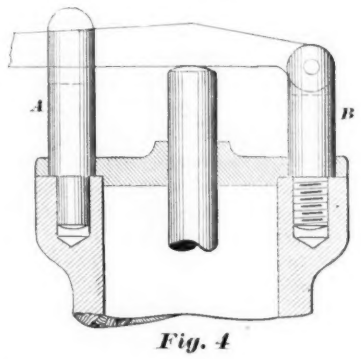


Fig. 4

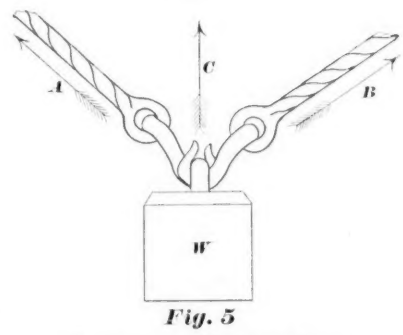


Fig. 5

Ethics in a Machine Shop.

wrong and because the drawing was followed by the workman—two things which, like the action of the two ropes in Fig. 5, cannot be separated in thought.

We cannot for a moment exonerate from blame the author of the defective drawing; neither can we avoid the conclusion that the recipient of the drawing is the finisher of the mistake, and for this he is in some degree responsible. The conditions under which a workman acts should make him see a mistake which, with the draftsman, was a mere slip of the pen. With a rule in his hand and a piece of stock before him, a workman should get no further before noting a self-contained mistake like Fig. 3. His mind should be ahead of his hands, and he should not cut unless he knows why he cuts.

In the last analysis, this reduces to saying that the more palpable the mistake, the less should it be followed and the less is the author responsible. I am well aware of this issue and do not dodge it. In illustration, if a machinist supply store receives an order for a ground stopper copper bottle to hold nitric acid and a glass hammer, there can be no interpretation other than the order contains a clerical blunder.

If a man claims that he is not at all responsible for unproductive outlay in trying to follow Fig. 3, because he did not see the mistake, he submits to a criticism upon his intelligence, which, in a sense, may cost him more than if he pocketed the loss himself.

I lately heard of a workman who knew that a drawing was wrong, but would not call attention to it because he had already twice been snubbed for doing the same thing. It is not clear how he could have been snubbed if he had called attention to real defects; if such was the case, he should have left the shop, because he could not expect to be justly dealt with in anything. There is a difference between fault-finding and defect-finding. Fault-finding may have been his defect.

As in all things, circumstances should influence in the interpretation of orders. It is in cases where the recipient goes on without first consulting each detail that I would so definitely hold him responsible. When an engine breaks down and new parts are ordered of the maker, in the hurry of such times the order is not explicit, yet it may then be ethical for the maker to at once act upon the best interpretation he can make.

When everyone feels his responsibility in the work he is doing—a responsibility that requires something more than *blindly* following instructions, there will be less unproductive labor in our machine shops.

The Western Waterways Convention at Memphis had representatives from seventeen States. The convention considered the importance of improving navigation on the Mississippi river and its tributaries, making an aggregate of more than 20,000 miles of navigable water.

It does not do for a Briton, resident of this country, to absorb too liberal ideas, not if he desires credit "at home." For instance, Andrew Carnegie's work, "Triumphant Democracy," is being soundly berated in England; still we think Mr. Carnegie will not be seriously troubled by the attacks that are made upon him.

Railroad Experience in Cuba.

We extract the following interesting points from a letter by F. F. Tynan, master mechanic of a Cuban railroad, to the *National Car and Locomotive Builder:*

We have one branch of our road where, owing to the very bad character of the feed water, the life of a crown sheet is only about eighteen months. Heavy scale forms very soon. I use no boiler compound, but a few days before an engine is brought in to change flues or flue sheet, I put about four pounds of common coal tar in the boiler every day for about six days, the engine being kept on some light

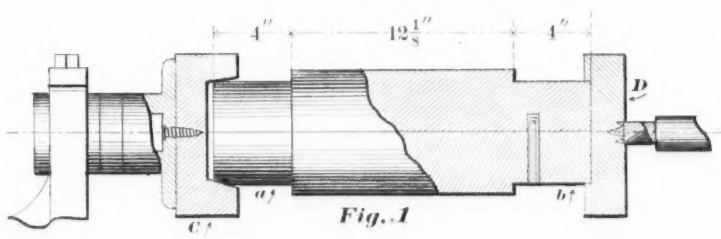


Fig. 1

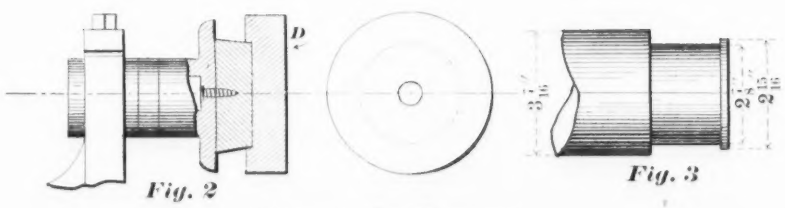


Fig. 2 *Fig. 3*

Altering Old Patterns.

service, so that she will not throw the water out of the stack. This loosens the scale so completely that no flue cleaner is needed to remove the scale, as it can be taken off with a piece of waste. This might be of service to master mechanics on your Western roads.

We have got English, Scotch and German locomotives here, but we do not want to have any more of them. All we get now are American, for we have proved that it only costs about half the expense to repair American engines that it takes to repair those of European make, and the former do nearly double the service of the latter, besides being easier to handle and more convenient in every way.

LETTERS FROM PRACTICAL MEN.

Altering Old Patterns.

Editor American Machinist:

In changing or altering old patterns, the reducing of patterns in diameter that have been turned up in halves, is, under certain conditions, a neat job. Some time ago we were requested to alter the core prints on a number of bushing patterns that were to be cast in brass, and as $\frac{1}{8}''$ was the amount allowed for finishing, it had to be done accurately. Fig. 1 is a sketch showing pattern chucked in the lathe; core prints *a* and *b* to be reduced from $2\frac{1}{16}''$ to $2\frac{1}{8}''$. To do this expeditiously we adopted the following plan, which may be used upon many occasions to advantage where it is desired to reduce the diameter of patterns by turning:

Select two pieces of hard wood, as much larger in diameter than core prints or ends of pattern as will be consistent with strength. Turn out a pocket in each piece to exactly fit the ends of pattern, as deep as may be deemed necessary, which in our case was $\frac{1}{8}''$ in piece *D* and $\frac{1}{2}''$ in piece *C*. To obtain the exact center in tailpiece *D*, rechuck it in the lathe, as per Fig. 2, and find center with a bradawl or any pointed tool, of the same size as center point on tailstock of lathe. The pocket in piece *C*, Fig. 1, should be a little smaller at bottom or cone shaped (see sketch), so that the pattern will be held firmly, and not slip while turning.

Then, tailpiece *D* having been made first, we allow piece *C* to remain on face plate of lathe, thereby forming a chuck for the reception of pattern. Slip on piece *D*, enter tailstock center exactly in center of *D*, Fig. 1, previously found, and we are ready for turning.

It will be perceived that if our pattern is in halves, they will be held together by end pieces *C* and *D*, and by reversing ends of pattern we can turn it to within $\frac{1}{8}''$ of the ends, which may afterwards be pared off with a chisel; see Fig. 3. Should the pattern be somewhat large it would be well to fasten pieces on ends with wood screws.

Wm. Hultgran.

Boiler Compounds—Feeding Boilers.

Editor American Machinist:

Never having seen much in the American Machinist in regard to the use of compounds for the removal of scale in steam boilers, I would like to have the opinion of some of your numerous readers in regard to them. As far as our own experience goes, we cannot say that we are favorably impressed with them. We have tried a good many of them, and it was claimed for all that they were the best in use. Anything that is strong enough to remove the scale is strong enough to affect the iron in the boiler, therefore we discontinued their use, and are making it a point to pump nothing but pure water into the boiler, by passing it through two heaters or lime extractors before entering the boiler. By doing this, we can run our boiler six weeks without cleaning it.

Some time since, a compound fiend induced our engineer to use some that he had, as usual, the best out. Soon the engineer came with the complaint that the flues were all leaking, which, of course, meant a job for the boiler-maker. He finally had to confess what he had done. We then made him blow it all out, and in a day or two the flues tightened up and we had no more trouble with them.

It is getting so now-a-days, that when you furnish a boiler to a party, they expect you to stand godfather for it as long as it lasts. A boiler of the very best material and workmanship can soon be ruined by putting it in the hands of an ignorant man. Around comes a boiler compound man with his stuff and gets the engineer to put in about two bucketsful of it. It sometimes lodges in a solid mass on the sheets. A sheet soon burns out and has to be removed and replaced by another one; then repeat the same thing again. Then the man who made

the boiler catches it for using bad iron, and his reputation is consequently injured.

Another cause of the burning out of sheets in the bottom of a boiler is the injecting of the feed-water into the ends, generally at the bottom. More or less foreign matter is carried in with the water and deposited on the sheet opposite the pipe opening, the result being, the sheet soon burns out. Then arises the question of bad iron again, and again the boiler-maker gets the blame. Some inject the feed water in the back head at the top, below the manhead, through a long perforated pipe. This, I think, is not a good plan, as by injecting the water into the steam space it then becomes a condenser. I think that all boilers ought to have a mud drum attached, and the feed water should be injected in the end of it on top; then any sediment that is carried in with the water lodges quietly on the bottom and can easily be blown off, or it may remain until cleaned out, as it never gets up into the boiler. By feeding the boiler in this way and pumping in water purified in the way stated above, there will be little need of using any compound whatever.

Benj. F. Hetherington.

Indianapolis, Ind.

Spontaneous Combustion.

Editor American Machinist:

The case of spontaneous combustion described below, seems to have taken place more promptly and with fewer of the elements supposed to be necessary to produce the result than common. A large block, which had been oiled with linseed oil, was wiped with a piece of clean waste at about 4 o'clock in the afternoon, and the waste thrown on the top of the truck which was used to take the block to the wagon. The truck was run back into the shop and left, when the next morning it was found with a hole, several inches in diameter, burned through the bottom. The waste was gone and a small pile of ashes was on the floor. It was evident that the waste lay over a crack between the planks, which were of hard wood. That the planks were of hard wood accounts for the fact that the fire died out after the waste was consumed.

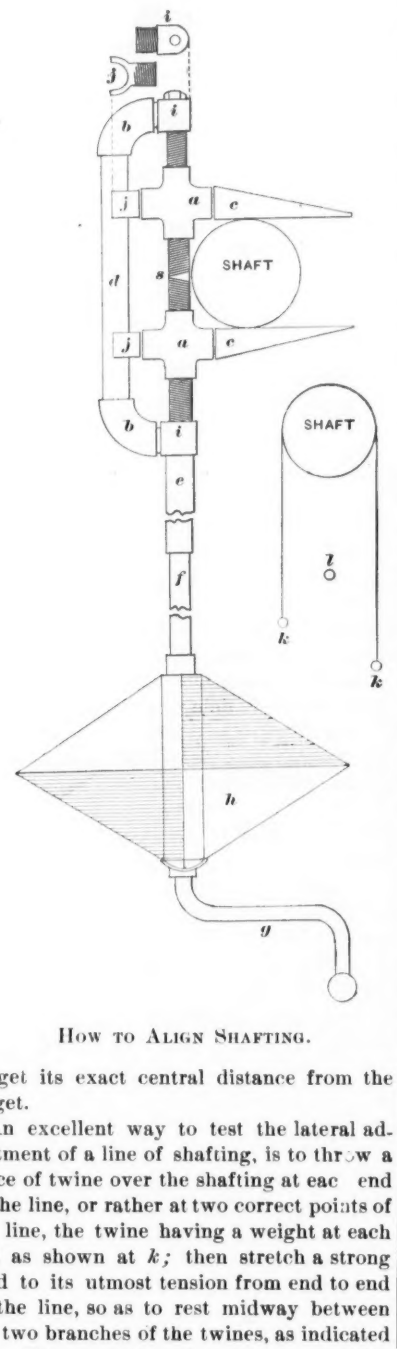
John E. Sweet.

How to Align Shafting.

Editor American Machinist:

The present sketch shows an improved implement to be used in testing the alignment of shafting. It is an improved modification of the device which was illustrated in Vol. 2 of the American Machinist. This is made of three pieces of gas-pipe, two crosses *a* and two elbows *b*. The jaws *c* are screwed into one branch of the crosses and the jaw guides *j* in the opposite branch. The other two branches are threaded right and left to work on the right and left screw *s* as shown. The screw is made of gas-pipe of smaller size, and works in the boxes *i*. The pipe *d*, the elbows *b*, the boxes *i* and the pipe *e* are screwed firmly together, and form the body of the tool. The pipe *e* must have sufficient length to bring the target *h* at the right height for easy observation when the jaws *c* are upon the shaft as shown. The pipe *f* slides into the pipe *e* telescope fashion, to serve as an extension to the implement when testing very high shafting. The crank *g* works the screw *s*. This crank is made of large wire which extends up through the pipes *f* and *e*, and enters a square hole in the lower end of the screw *s*, the wire being squared a sufficient length at its upper end to accommodate the range of the pipe *f*. If great accuracy is desired, a spirit level may be affixed to the target by which to plumb the rod, but sufficient accuracy and greater facility may be secured without the level.

With this device and an engineer's telescopic level a long extent of shafting may be quickly tested. The reader will perceive that this implement always gives the distance from the center of the shaft, whatever its diameter, so that when various sizes of shafting occur in the same line, it is only necessary to bring both jaws in contact with the shaft by means of the crank *g*, as shown,



How to Align Shafting.

to get its exact central distance from the target.

An excellent way to test the lateral adjustment of a line of shafting, is to throw a piece of twine over the shafting at eac end of the line, or rather at two correct points of the line, the twine having a weight at each end as shown at *k;* then stretch a strong cord to its utmost tension from end to end of the line, so as to rest midway between the two branches of the twines, as indicated at *l*. Throw another piece of twine—with a weight at each end—over the line at the points to be tested, and if the cord is still midway between the two branches of this plumb at these several points, the lateral adjustment of line is correct.

F. G. Woodward.

Hydraulic Jack.

Editor American Machinist:

I have lately constructed a hydraulic jack which is represented in Figs. 1 and 2. The

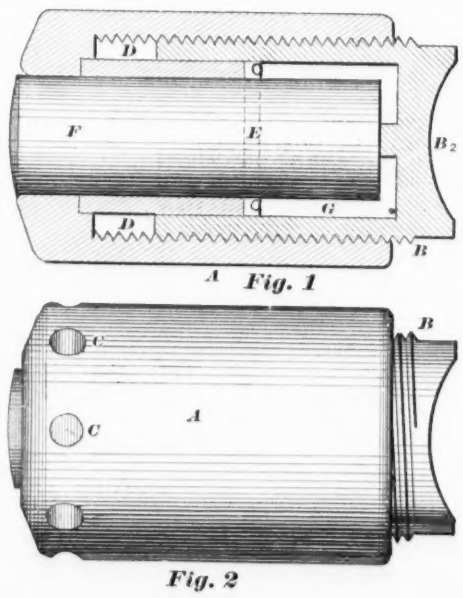


Fig. 1

Fig. 2

Hydraulic Jack.

device I believe to be new, and was made for the purpose of pressing piston rods out of crossheads.

Fig. 2 represents an outside view of the jack as it appears when ready for use. Fig. 1 represents a section of the same. The outside shell marked *A* is threaded on the inside and screws on the chamber *B;* its end, B_2, is concaved to prevent it from slipping off the crank pin. The gland *D* is made to fit the inside of the chamber *B* and also the outside of the plunger *F*. The space *G* is filled with water or other liquids, and to prevent leakage, a leather packing *E* is fastened to the end of the gland *D*. To operate this jack we simply place a bar into one of the holes *C, C*, and screw the outer shell *A* on the chamber *B*, forcing the gland *D* further into the chamber *B*, and thereby causing the plunger *F* to move outward. This device is not patented, and you may publish it for the benefit of your readers.

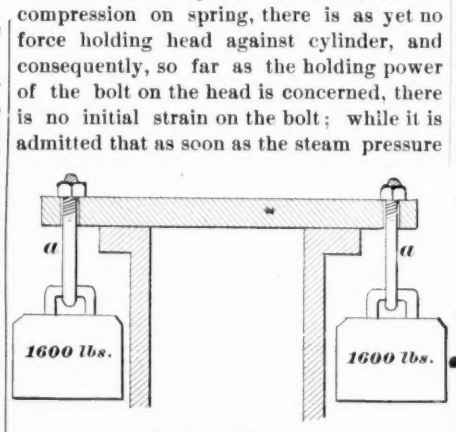
H. A. Cooper.

Initial Strain Again.

Editor American Machinist:

Although this subject has been quite fully discussed in your columns, I think the annexed sketch may clear up the matter in the minds of those of your readers who are still in doubt or error. Assume a cylinder head to be held against steam pressure by weights hanging outside, as in diagram, instead of the customary studs or bolts, each weight representing say 1,600 lbs., or what would be the initial stress on bolt. Obviously the pressure upon the inside of head will not increase the strain upon hangers *a* in the least. It is of course assumed that the initial strain is in excess of that induced by the steam pressure, which must always be the case, or there would be leakage at the joint.

I think W. W.'s illustration in your issue of Oct. 29, of placing a spring under compression between cylinder head and *flange*, does not represent the actual conditions of the case. If, as he says, we suppose a small separation between head and flange, and the bolt be screwed up until there is 1,600 lbs.' compression on spring, there is as yet no force holding head against cylinder, and consequently, so far as the holding power of the bolt on the head is concerned, there is no initial strain on the bolt; while it is admitted that as soon as the steam pressure



Initial Strain.

exceeds the initial strain the bolt commences to receive the pressure, but not before. W. W. can get no good of his bolts until the surfaces are in contact, and the nuts screwed down beyond the compressive force of spring; and if the additional screwing down amounts to 1,600 pounds' strain, he will have 3,200 lbs. on each bolt, 1,600 lbs. of which is represented by the spring. In this condition the bolts will receive no additional strain from the steam pressure, until it exceeds 1,600 lbs on each bolt.

In illustrating with a spring, it should, for a proper analysis of the subject, be placed between the head and *nut*, as has been suggested by Mr. W. H. Booth in your Nov 12 issue.

W. J. Creelman.

Rochester, N. Y.

Examination of Locomotive Engineers.

Editor American Machinist:

J. J. Clair (see issue of Nov. 12th) evidently does not understand me. I do not think engineers should be examined by political appointees, but by the method Mr. Hill advises. I merely suggested that it might be a good idea to examine engineers on the care and management of engines at the same time, by the same parties. If an engineer "kicks" against that, it looks as though he did not understand his business. I was thinking more particularly about firemen being examined at the time they were promoted, than of the engineers who are now running.

Perhaps it is not the practice in Mr. Clair's State, as here, to promote the senior fireman without a question. I think that if they knew they had to pass some kind of an examination, it would make a vast difference with some of them.

I did not claim that some engineers were criminally careless in running their trains, but in the use of supplies, and in switching. I know as well as Mr. Clair, that locomotive engineers will average above the other trades, but we are not all perfect yet.

Mr. Clair says, "Common sense will tell me there is no brake perfect." Very true; I understand all that, but at the same time, if a man does not know the brake thoroughly, and especially the one thing I mentioned, there is always a chance for that man to get into trouble from the lack of that knowledge. I claim that there are men running who do not. If there are none on the road Mr. Clair works for, the company is fortunate.

I am very much interested in Mr. Hill's letters. Let us hear from him on this subject.

J. F. Marsh, Engineer.

Calculation versus Trial.

Editor American Machinist:

I cannot agree with Mr. Coffin that fine calculations on Prof. Sweet's spring rollers would be a waste of time. When I saw Mr. Coffin's article, I thought I would experiment a little with the cost of the calculation; so I took a piece of paper, put down the formula and dimensions, and looked on my watch. It took me exactly ten minutes to calculate the thickness of the roller with four decimals. Now I think it very likely that it would take ten minutes to hunt up an old bush, suitable for the first trial, and then we are only just ready to commence the calculation. I think that in most cases the thickness can be got close enough by calculation, without any trials. I have calculated spiral springs by formulas and have come within three per cent. of the right size every time; and I think this is the very cheapest way to do it.

J. Begtrup.

Will Cut 11 3-7 Threads.

Editor American Machinist:

Your correspondent, "Subscriber" (see Question and Answer No. 451), can cut a thread so near 11½ to the inch there is no fun in it, by using 28 on the stud, and 80 on the screw, and it will no doubt answer his purpose if the screws wanted are not longer than gas pipe threads. C. E. Albro.

[These gears would cut 11⅜ threads to the inch, and as Mr. Albro says, would probably be near enough for most jobs of pipe threading.]

The fact that iron beams for building purposes have recently been imported in considerable quantities does not look as if the tariff on these articles was excessive.

Professor Dobroslawin, of St. Petersburg, has been making experiments on the condition of the air and the temperature in theaters lighted by gas and by electricity. His conclusions are all in favor of electricity for lighting purposes.

Once in about ten years the process of instantaneous generation of steam is rediscovered somewhere in the world. It always saves a good deal more fuel than is lost in the old processes, besides having many other advantages. Still, the users of steam perversely go right along boiling water in the old-fashioned way.

The habit of looking to Wall street as the index of business is not satisfactory, yet a dull state of business there sometimes frightens sensible people into the belief that business generally is bad. A look through the workshops and manufactories of the country is the true way to find out how business really is. Nothing but disaster is produced on Wall street, and this does not enrich the country, it is needless to say.

Barnes' Tube Cutter.

The engraving represents the construction of this cutter, which will be seen to be simple. There is nothing but the knives subjected to wear, and these can be quickly replaced. It is so constructed that by loosening the set screw the guard may be so adjusted as to cut the tube either inside or outside of the boiler-head, thus answering for removing tubes to be repaired, or trimming new boilers. When the tube is cut it is ready to be welded, and saves again cutting in a lathe, and saves that much of the tube. It is manufactured in all sizes by the Boiler Tube Cutter Manufacturing Co., of Liverpool, N Y.

Modern Locomotive Construction.

BY J. G. A. MEYER.

FIFTY SECOND PAPER.

FRAMES, CONTINUED.

Built Up Frames.—Fig. 297 represents a frame which may be called the built up frame, because, instead of it being forged in one piece, the same as all the frames previously shown, the lower brace L is fitted between the pedestals and bolted to the same. This class of frames is looked upon with favor by a number of master mechanics, and comparatively is used to a small extent. In our opinion, the built up frame is not as good a frame as either one of the solid frames shown in Figs. 292 and 295; it is lacking that simplicity which is so desirable and essential in a locomotive.

The frame represented in Fig. 297 is one of the frames used in a number of consolidation engines having cylinders 20 inches in diameter. We consider frames of the dimensions given to be too light for engines with cylinders 20 inches in diameter.

Light Frames—It has been found that when the depth B_2 of the upper frame brace is the same throughout, as shown in Figs. 292 and 295, and when the brace is rather light for the forces which it has to resist, fracture will take place somewhere in the neighborhood marked B_3 in Fig. 297, near the pedestal, and seldom midway between the pedestals. Consequently, when it is necessary to make the frames as light as possible to comply with given conditions of a railroad, or when a load must be hauled with a locomotive of minimum weight, as on elevated railroads, the weight of the frames can be reduced by making the depth B_2 of the upper brace less at the center of that portion of the upper frame brace which connect any two pedestals as shown in Fig. 297, without weakening the frame. When the depth of the brace midway between the pedestals is to be reduced, then make the cross-sectional area and the depth B_3 near the pedestal, equal to that found according to Rules 32 and 33; and for the center of the upper frame brace, reduce the depth so found in about the same proportion as shown in Fig. 297.

For ordinary locomotives in which a little extra weight is not objectionable, in fact, where this extra weight is often desirable, it is always best to leave the depth of the upper frame brace the same throughout, and plane the under side of the brace. By so doing, an advantage will be gained, which at first sight may appear trivial, but which, in private locomotive shops, is appreciated. We allude to the bolts which are required for bolting the mechanism to the upper frame braces. These bolts are generally made before they are actually needed in the erecting shop, and according to dimensions obtained from the drawing room. If now the upper frame braces are equal in depth throughout, and planed to correct dimensions, not only will confusion, and sometimes the necessity of throwing bolts away, or often altering the lengths of bolts, be avoided, but the time lost by the workmen waiting for bolts, and the delay in getting the engine out of the erecting shop, will be prevented, which otherwise would have amounted to quite an item of loss to the proprietors.

Slab Frames.—Sometimes it is desirable, and particularly so in narrow gauge locomotives, to obtain more room between the frames for the fire box of the boiler than can be obtained by leaving the frames the full width throughout. In cases of this kind the width of the upper frame brace B_2 along the side of the fire box is reduced, as shown in Fig. 299, and the depth of the brace B_2 increased, as shown in Fig. 298. In designing locomotives of this kind, precautions are taken to bring the bottom of fire box within one inch from the top of the lower frame brace L, and never allow the bottom of the fire box to extend below the brace L; by so doing the lower frame brace is allowed to remain in full width of the frame, and room is also provided for the spring gear.

When the upper frame brace is to be made in the form of a slab, as shown, its cross-sectional area for any given diameter of cylinder should be equal to that of the brace suitable for the same diameter of cylinder, and found according to Rule 32. The width of the slab is arbitrary and is generally made as small as is practicable in the designer's judgment. The least thickness of slab that we have seen was $1\frac{1}{4}$ inches, used on a locomotive having cylinders 15 inches in diameter; the depth of the same brace was $7\frac{1}{2}$ inches.

From the foregoing we can establish the following rule for finding the depth of the frame brace B_2 when it is to be of the slab form:

Rule 34.—First find the cross-sectional area of the frame brace, according to Rule 32; then divide this area by the given width of the slab; the quotient will be the depth of the upper frame brace or slab.

Ex. 64.—What should be the depth of the frame brace B_2 whose width is $1\frac{1}{4}$ inches, for a locomotive having cylinders 14 inches in diameter. The maximum steam pressure in the cylinder is to be 120 per square inch.

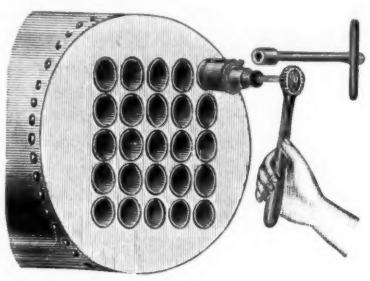
The area of a piston 14 inches in diameter is 153.94 square inches. Hence, according to Rule 32, the area of the upper frame brace will be.

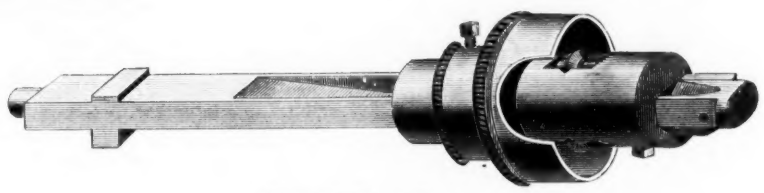
$$\frac{153.94\times120}{2{,}000}=9.23+\text{ square inches.}$$

According to Rule 34 the depth of this brace will be

$$\frac{9.23}{1.25}=7.38\text{, say } 7\tfrac{3}{8}\text{ inches.}$$

Front Splices for Passenger Locomotives.—The general design of the front splice, or sometimes called the front end of the frame, depends upon the class of locomotives in which it is to be used. Fig. 290 represents the front splice for an eight-wheeled passenger locomotive. The manner of fastening the front splice to the main frame is dependent on the kind of pedestals adopted. The manner of fastening the splice to the frame, or we may call it the connection between the two, when pedestals with cast-iron thimble and bolt are used, is shown in Fig. 289. In this connection the keys M M are usually placed in a position which will necessitate the drilling out a small portion of the keys so as to allow the bolts N N to pass through the frame; this will prevent the keys M M from working out of position.





BARNES' TUBE CUTTER.

In Fig. 291 is seen the manner of fastening the splice to frame when pedestals with wrought-iron caps are used. In this connection the bolts M M which fasten the T end of the splice to the pedestal leg are liable to give trouble or break; to prevent this, great care must be taken in determining the diameters of these bolts, and make them as large in diameter as possible without impairing the strength of the pedestal leg. To determine the diameter of these bolts we have the following rule, which is based upon observation.

Rule 36.—Multiply the width of the frame in inches by the decimal .32, the product will be the diameter of the bolt in inches for fastening the T-end of splice to pedestal leg.

Ex. 65.—What should be the diameter of the bolts for fastening the T-end of splice to pedestal leg? The width of frame is 4 inches.

$$4\times.32=1.28\text{, say } 1\tfrac{1}{4}\text{ inches.}$$

These bolts have usually conical heads and countersunk into the pedestal leg.

In this connection of splice to frame, it is also of great importance to have a sufficient number of bolts N N to hold the end of the frame to splice. The diameter of these bolts should be equal to about $\frac{1}{4}$ of the width of the frame, and the shearing stress should not exceed 3,000 pounds per square inch. Assuming as before, for the sake of simplicity, that the total pulling force is equal to the total steam pressure on the piston, we can use for determining the number of bolts through frame and splice, the following rule:

Rule 36.—Divide the total steam pressure on the piston in pounds by 6,000; the quotient will be the total cross-sectional area of all the bolts; divide this quotient or total cross-sectional area by the cross-sectional area of one bolt; the quotient will be the number of bolts required through the end of frame and splice.

Note.—The reason for dividing the total steam pressure on piston by 6,000 instead of 3,000 is, that some of these bolts, sometimes all, are subjected to a double shear, that is to say, they must be sheared off in two places before the frames can be pulled apart.

Ex. 66.—What should be the number of bolts marked N N in Fig. 289, passing through the end of frame and splice, for a locomotive having cylinders 18 inches in diameter, maximum steam pressure in cylinder, 120 pounds per square inch? The diameter of each bolt to be equal to $\frac{1}{4}$ the width of the frame.

In Fig. 271 we see that the suitable width of frame for a locomotive having cylinders 18 inches in diameter is 4 inches; hence the diameter of each bolt must be 1 inch. The cross-sectional area of a bolt 1 inch in diameter is .7854 of a square inch.

The area of a piston 18 inches in diameter is 254.47 square inches; hence, according to Rule 36 we have $\frac{254.47\times120}{6{,}000}=5.069$ square inches = total cross-sectional area of all the bolts; and $\frac{5.069}{.7854}=6.4+$ say $7=$ the number of bolts required.

If the connection of frame and splice is similar to that shown in Fig. 289 and the number of bolts found according to Rule 36, and also assuming that the total pulling force is equal to total steam pressure on the piston, the shearing stress per square inch of cross-sectional area of the bolts will appear to be greater than 3,000 pounds, because four of the bolts N N are subjected to a shear in one place only, but the keys M M will reduce the shearing stress to less than 3,000 pounds on the bolts, so that the foregoing rule can be safely applied in designs of this kind.

Ex. 67.—What should be the number of bolts N N, Fig. 291, passing through the end of the frame and splice for a locomotive having cylinders 14 inches in diameter, the diameter of each bolt to be equal to $\frac{1}{4}$ of the width of the frame? The maximum steam pressure in cylinder is equal to 120 pounds per square inch.

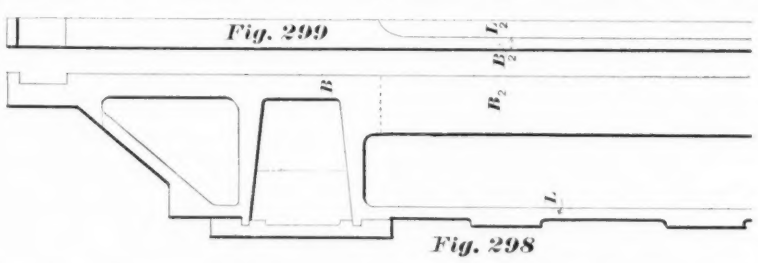


Fig. 299

Fig. 298

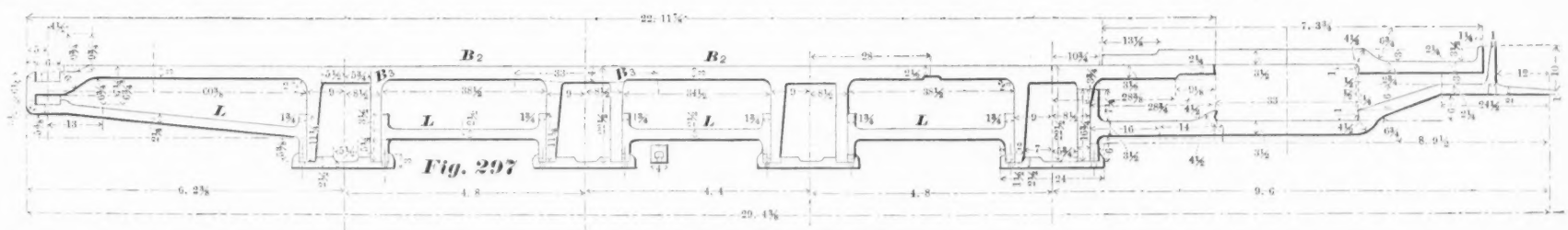


Fig. 297

Frame Four Inches Wide.

In Fig. 275 we see that the suitable width of frame for a cylinder 14 inches in diameter is $3\frac{3}{4}$ inches, consequently the diameter of each bolt N N must be $\frac{3\frac{3}{4}}{4}=\frac{15}{16}$ of an inch. The area of piston 14 inches in diameter is equal to 153.94 square inches; hence, according to Rule 36, we have

$$\frac{153.94\times120}{6{,}000}=3.0788\text{ square inches for the}$$

total cross-sectional area of all the bolts. The area of bolt $\frac{15}{16}$ of an inch in diameter is equal to .69 of a square inch, and

$$\frac{3.0788}{.69}=4.4+\text{ say 5 bolts.}$$

The Apollo, a new screw steamer built for the Bombay trade, in England, is 330 feet long, and has triple expansion engines with cylinders 25 inches, 40 inches and 66 inches in diameter by 48 inch stroke. Working pressure, 160 pounds.

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Our Tenth Anniversary.

With this issue, the American Machinist begins its eleventh year of publication. Our readers know that we do not make a practice of publishing commendatory letters or expressions of approval. Many such reach us, but few are published, our view being that to continue to deserve them is the best evidence of appreciation we can offer.

The continued steady growth of our circulation is another sign, and this also is a very welcome one, that our work is acceptable to the mechanical public. Concurrently with this, we are glad to say, come abundant proofs that the mechanics of the country are influential in the establishments and enterprises with which they are connected. Looking back over the record of the past ten years, we feel assured that the measure of credit due to the American Machinist, its contributors and its friends, for their share in the development of technical journalism in this country, need not be estimated here.

No change in the general plan, policy or scope of the paper is contemplated or needed, for the future. Improvements we have always in view—we never expect the day to come when we shall not hope to do just a little better in the future—but they are of the kind which all our readers who are acquainted with our methods and motives are justified in expecting.

Liability for Accidents to Workmen.

A few years since, upon the passage of what was known as the Employers' Liability Act in England, an insurance company was formed, which, for a certain percentage of the pay roll of an employer, relieved him of all legal responsibility for any accidents which might happen to any person in his employ. That is to say, any employer holding one of the policies of this company, and in whose establishment an accident should occur by which a workman should be injured or lose his life, and who, being sued for damages resulting from such accident, had nothing to do except to hand the summons to the insurance company. This company would then either settle the case upon the best terms possible or fight it in the courts and finally pay whatever damages were awarded, if any—the employer having nothing further to do with the matter. Recently the business of the company has been extended into this country, and we are led to reflect a little upon the nature of the business which it proposes to do.

It is a well recognized principle of the fire insurance business that things must be so arranged that some of the loss resulting from fires must fall upon the policy-holder. This is deemed necessary to protect the insurance company from losses by carelessness and incendiarism. Without this feature it is considered, and in fact experience proves, that there is not sufficient incentive to the exercise of proper care in the avoidance of fires, and what is called the "moral hazard" becomes too great.

It seems to us that this company, by ignoring this principle in the conduct of their business, is removing what is in many cases the strongest incentive to the exercise of due care in the avoidance of accidents; viz.: the knowledge that carelessness in such matters will probably have to be paid for sooner or later, and may prove in the end much more expensive than the proper precautionary measures necessary to avoid such accidents.

We are not informed as to whether or not this company requires those employers whom it insures to adopt and maintain all proper and lawful means for the avoidance of accidents, but probably not; because the adoption of such means by the employer would relieve him of all liability, and obviate all necessity for the insurance.

Losses by fire are not always to be avoided, and it is therefore proper, after taking every possible precaution, to insure against the remaining risk. But such losses as this company proposes to insure against are avoidable, because damages are not awarded in such cases by the courts unless it be proven that the employer, by his neglect of proper precautions, is responsible for the accident. It is therefore clear that, after all is done which can be done, or which the law requires to be done, for the avoidance of accidents, there remains no risk to be insured against, and such insurance becomes absolutely worthless.

Here the question naturally presents itself whether or not an employer of labor who takes out a policy in this company is thereby confessing that he does not take proper measures to avoid accidents, that he knows he does not, and that he does not propose to do so.

Then, too, we think that workmen usually have difficulty enough in obtaining what is justly and lawfully due them as compensation for injuries received, without having in every case to contend with a powerful and wealthy company, organized especially for fighting such cases, and possessing all the well-known advantages in the courts which the possession of wealth confers and by which justice is frequently, even commonly, defeated.

From motives of justice and humanity we hope to see employers of labor here and everywhere who have not already done so make use of every possible precaution against accidents, and we firmly believe that when this is done the risk arising from the chances of damages being assessed by the courts in such cases will be reduced far below the point at which it is worth while to talk about insuring against it, to say nothing of its better appearance from the standpoint of justice and humanity.

Machinery Trusts.

Two of the latest examples of "trusts" are those in steam engine governors and in machine screws. Undoubtedly the price of both these articles has been, for some time past, too low, but we think that in the end the trust will be found an unwise means for increasing it. The modern trust is distrusted by the major part of the people of this country. It is especially at variance with the practice of protection, which is based upon the assumption that free competition shall come in to guard the consumer. Now, when the "trust" assumes to control production, it strengthens the argument of those who claim that the tariff is already too high, and this argument is used to-day for all it is worth. It is the most difficult argument the friends of protection are called upon to meet. In saying this we do not assume that the argument is right; we simply state the fact that the opponents of a high tariff are strongly fortified by the operation of the modern trust.

Take the examples named, viz.: that of steam engine governors and machine screws. Both are protected by tariff to an extent even beyond the difference in the cost of production as between here and in Europe. Now, no one would complain of this if home competition was left free to regulate the price to the consumer, but when artificial means are used to govern this price, it may be set down as certain that "tariff reformers" will take advantage of it.

In the matter of governors, there are fifty makers, more or less, who have been kept out of active competition by the low prices that have prevailed. When the governor trust gets fairly into operation, these makers will come into the market. They will avail themselves of the skilled commercial travelers who are thrown out of employment by the operation of the trust, and the tendency will be to keep prices down. But this is not the purpose of the trust. And nothing can follow but that which follows in every case of the kind—the taking into the trust of all these competing builders, or the ruthless crushing out process, which is the common practice. Either of these must follow, or the trust will fail, which is perhaps the most reasonable thing to expect.

In regard to the individual firms that have gone, or will go into either of the two trusts referred to, it may be assumed that the products of some of them are better than the products of others; and that in that respect they are in better shape to keep in competition. If they are willing to pool their issues with those not in so good condition to compete, what conclusion can be arrived at than that some advantage is to be taken of consumers.

The establishment of trusts in the various machine interests in this country would be a calamity, in that it would tend to prevent progress, and, as previously intimated, would be quite certain to bring about adverse tariff legislation.

There is not a harder problem to deal with in a machine shop than what disposition to make of old tools. Too good to put in the cupola and too poor to use is a very common condition of such machines as lathes and planers. A new tool does not need to be much better than the old one to make it possible to earn a good deal more with it, so the question of replacing old machines may be made a question of arithmetic. A little figuring in many machine shops would provide considerable cast-iron for the cupola, and work for tool builders, to the advantage of all parties. Poor tools at the present day effectually put a shop beyond the possibility of competing with those well equipped. There is no way to successfully compete except to take advantage of the progress made in the construction of machine tools.

The question of the economic value of steam jacketing cylinders appears to be no more nearly settled in Britain than here. The fact seems to be fairly established, that under certain conditions, steam jacketing shows an important gain, while under other conditions there is no gain, but, on the contrary, a loss. The difficulty seems to be in determining what conditions call for a steam jacket. Further experiments seem to be required.

Literary Notes.

John Wiley & Sons, 15 Astor Place, New York, issue a sheet detailing new works which they have in preparation, and nearly ready to issue. Included in this is Part II. of Kinematics, or Practical Mechanism, by Prof. MacCord.

The Pattern Makers' Handybook is the title of a new book intended to furnish information to pattern makers and their apprentices upon the principles involved in the business.

Numerous illustrations of tools, fixtures, and processes are given, together with a glossary of terms, and we have no doubt but that it will prove useful to those for whom it is intended. It is published and sold at 2s. (50c.), by Crosby, Lockwood & Son, London.

Questions and Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(471) P. S., Kent, O., asks: Will you please state how the clouded color is produced on hardened steel pieces, such as gun locks? *A.*—Gun locks are not usually made of steel, but of iron. The appearance you speak of is the result of skillful case-hardening, a process which is described in the American Machinist of Feb. 25, 1882.

(472) Several correspondents write that the receipt to which T. C. W. referred, for chapped hands was: 1 ounce glycerine, ½ ounce bay rum, ½ ounce spirits of camphor, to which add the juice of two lemons. Apply after washing.

(473) S. J. A., Buffalo, N. Y., writes: Please inform me what an ordinary vacuum gauge shows, pounds or inches? and what are the proportions between pounds and inches? *A.*—See answer to question 237, AMERICAN MACHINIST, May 28, 1887.

(474) C. C. B., East Vassalborough, Me., writes: Please inform me if a 9/16 x 12 inch steam port and a 2″ steam pipe is large enough for an engine having a 12″ x 20″ cylinder, and making 125 revolutions per minute. *A.*—They are too small; the steam port should be 9¼″ x ¾″. The steam pipe should be not less than 2¾ inches in diameter. See AMERICAN MACHINIST, page 5, Sept. 5, 1885, and page 6, Sept. 12, 1885.

(475) C. G., La Crosse, Wis., asks: 1. How is ordinary tracing or vellum cloth glazed, and made transparent? *A.*—The method is a trade secret and we cannot obtain it. 2. What is the thinnest and most transparent brand of cloth now in the market? *A.*—The choice lies between a brand called the "Imperial," and a brand known as "Sagers." There used to be a brand called "Excelsior" which was thinner than the other two brands; it is now out of the market.

(476) D. A. G., Southbridge, —— writes: I wish to know if in burning soft coal, most of it very fine, there is any advantage in wetting it; if so, how much water to the ton? My boilers are tubular with fine grate. *A.*—The only advantage gained by wetting coal, is that when the coal is very fine the dampness will prevent the fine particles of coal from being drawn through the flues, and thereby save fuel. Nothing is gained by wetting large coal; in fact, it will be disadvantageous to do so.

(477) A. G., Newark, N. J., asks: How many pounds of water evaporated per hour at 90 pounds' pressure is equal to one horse-power, and how is the calculation made? *A.*—That will depend upon what kind of an engine you use the steam in. One engine may use 30 pounds; another 60 pounds. Engineers frequently agree to call the evaporation of 34½ pounds of water from and at 212° as equal to one horse-power. You will find in works on the steam engine tables by the use of which you can compute how much water you should evaporate under 90 pounds' pressure, and from the temperature of feed, which you do not give, to equal this.

(478) J. F. G., Chanute, Kan., asks: 1. If the amount of power required to revolve a wheel 1,000 revolutions per minute in he open air be 10, how much power will it take to revolve the wheel at the same speed in an air chamber in which the air is compressed to 150 pounds per square inch. *A.*—It is impossible to answer this question definitely without a full statement of the conditions. We do not think, however, that there would be much difference in the amount of power required. 2 Has any machine ever been invented that would run by compressed air, compressing its own air, and running entirely independent of any other power? *A.*—No such machine has ever been invented, and never will be, because it requires more power to compress air than can be derived from it, by its expansion, to say nothing of the loss by friction.

(479) J. F. C., Portland, Me., writes: I wish to build a windmill, and as all one-wheel mills tend to revolve themselves around the central shaft when resistance is appled to it, I thought of using two wheels, one smaller than the other. The small wheel is head to the wind, because the wind is unobstructed that operates it. One wheel is to run opposite to the other. Now, if resistance be applied to the central shaft, which may be connected by proper miter gears, and the wheels are proportioned correctly, the wheels will stay head to the wind and revolve with the wind as it changes, using a fan or tail, of course, as in other mills. Now I wish to ask you if such a combination would be practicable. *A.*—In our opinion, your idea of building a windmill is not practical. The trouble in one-wheel mills to which you refer is overcome, we believe, by first-class builders of windmills.

(480) H. C. H., St. Louis, Mo., writes: I enclose a rough sketch of an appliance for use on cable roads, the principle of which is the combination of grip and brake into practically one machine, and its object the release of grip, application of brake (or *vice versa*) emanating from one mechanical motion. The practicability of the parts above the conduit, are, I think, unquestionable, and what I desire to know is, 1. Will the power exerted by the wedge be sufficient to withstand the necessarily great strain? *A.*—It can be made so. 2. Does the device contain any ideas worthy of consideration? *A.*—No, it does not, because in the way you propose to take hold of the cable, it will soon be torn to pieces, as no allowance has been made for slip. Again, cars are run on the North Hudson County Cable Railway, N. J., on which the grip and brake are operated by one wheel, as you propose to do, but by different mechanism. Your idea is not new.

(481) W. A. R., St. Louis, Mo., writes: Will you please give me the horse-power required to run an exhaust shaving fan 54 inches in diameter, 14 inch blade, and running 1,360 revolutions per minute. The suction pipe to planer and other machines is 20 inches in diameter, and we will say 40 feet long. The exhaust pipe is 20 inches in diameter and runs in a direction perpendicular to the roof, from thence to a cyclone dust separator 50 feet from the fan and then falls by gravity into the shaving vault in boiler room. Please give rule. *A.*—It is impossible to give exactly the horse-power required to run your fan without knowing more about the arrangement of your pipes. The power also depends upon the kind of blower used, as blowers made by some makers require more or less power than those made by other makers We have always found it best to write to the manufacturer of the blower for an estimate of the power required to run it, and have always found the estimated power so obtained to be quite correct.

(482) A. M. D., Lancaster, Pa., writes: I am running an engine in which the feed pump gives me a great deal of trouble. It is an old belt pump and works all right when the air chambers are all right, but the air chambers do not hold the air. The air chambers are made of pipes 2½ inches in diameter and 3 feet long, the ends are closed with caps screwed on the ends of the pipes. The pipe which supplies the pump is one inch in diameter, and I believe is too small for the pump. I have done all I could to make the air chambers tight, used galvanized iron pipe for the air chambers, and cemented the caps, and still the air chambers leak. Now, I think the air escapes through the pores of the iron. Am I right? *A.*—You are wrong; the trouble with your air chambers is caused by bad workmanship; to overcome this trouble employ a good mechanic, or what is better still, procure good cast-iron air chambers correctly proportioned and designed for the purpose, and put on the pump by a mechanic. As for the size of the suction pipe, we cannot say whether it is too large or not; you have not given us the size of the pump.

(483) W. H. S., Kittanning, Pa., writes: 1. In examining the valve gear of a number of locomotives, I find in a great many of them, when in full gear forward, the hanger pin in the end of the lifting shaft arm is coincident with the center of the rocker shaft. Is it possible in this case to have equal lead in full gear without lengthening the eccentric rod and thereby destroying the symmetry of the motion? *A.*—Yes, it is possible, and not only possible, but generally the engines have equal lead when in full gear forward. When the connections between the main driver and the valve are correctly proportioned, the lead of the valve is equalized by setting the eccentrics in the proper positions. The length of the eccentric rods must be such that the valve will be made to travel through equal distances on each side of its central position. See "Laying out Link Motion," AMERICAN MACHINIST, page 4, May 17, 1884. Equalizing the lead will seldom if ever interfere with the length of the eccentric rods. We have frequently noticed, that when the valve gear is correctly laid out, the hanger pin at the end of the lifting shaft will very nearly coincide with the center of the rocker shaft when the engine is in full gear.

(484) R. W. T., Norwich, Canada, writes: Will you please answer the following questions: 1. What pressure per square inch will air register, compressed to one-half its bulk? *A.*—When the temperature remains the same, the air will register double the pressure. See AMERICAN MACHINIST, page 4, July 9, 1887. 2. Will air compressed to 40 pounds pressure register 80 pounds if forced into one half the space? *A.*—Yes, providing the temperature remains the same. 3. Would say six horse-power be sufficient to compress air into a boiler or air chamber by means of an air pump or any other method to raise a pressure of say 80 pounds per square inch and keep another engine running fed from said chamber and giving six horse-power? of course allowing friction of pumps and engine; or in other words, can the same amount of power be taken from compressed air that it requires to compress it minus the friction of engine, etc.? *A.*—Theoretically you should be able to obtain the same amount of power from the compressed air as that required to compress it. Practically it is difficult to do so, as considerable power is lost by the heat generated in compressing the air, and part of this heat will be wasted; probably you will not obtain more than 60 per cent. of the power used in compressing the air. 4. What is the most convenient way of compressing the air? *A.*—There are air compressors made for this purpose.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Gear Wheels. See Adv., page 16.

Link-Belting.

Send for catalogue of Link-Belting.

Over 50,000,000 feet of Link Belt in use.

Link-Belt Machinery Co., Chicago and N. Y.

Shafting Straighteners. J. H. Wells, Tampa. Fla.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

Exhaust Tumbl'g Bbls. Henderson B'.s, Waterb'y Ct.

Lamb Knitting Machine Co., Chicopee Falls, Mass.

Machine work and patternmaking. Anderson Machine Works, Peekskill, N. Y.

Light articles built to order by the American Sewing Machine Co., Philadelphia, Pa.

For Electric Recording Steam Gauge, write Telemeter Co., 44 Barclay st., New York.

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

For Catalogue of 2d hand lathes, planers, etc., write to John Steptoe & Co., Cincinnati, O.

For the best and cheapest four-horse engines, address Peter Walrath, Chittenango, N. Y.

R. Dudgeon, 24 Columbia st., New York. Improved Hydraulic Jacks and Roller Tube Expanders.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

Solid Nickel-Seated "Pop" Safety Valves. Consolidated Safety Valve Co., 111 Liberty st., N. Y.

Davis Key-Seating Machines, kept in stock, by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

"How to Keep Boilers Clean." A book mailed free, by James E. Hotchkiss, 120 Liberty st., N. Y.

Ice and Refrigerating Machines, 124 built, and all successful. David Boyle, 521 Monroe st., Chicago, Ill

Selden Packing, for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Drawing Materials, all kinds. Get catalogue. Mention this paper. G. S. Woolman, 116 Fulton st., N.Y.

Buy the Excel. Upright Drill; sizes, 20″, 25″, 28″, 32″, 36″ swing. Currier & Snyder. Worcester, Mass.

The Improved Tabor Steam Engine Indicator, made and sold by The Ashcroft Mfg. Co., 111 Liberty st., N. Y.

Engine Lathes, Hand Lathes, and other fine tools. Assortment large; prices low. Frasse & Co., 92 Park row, N. Y.

For the latest improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

Inventors should write R. G. DuBois, Patent Attorney, 916 F street, Washington, D. C., for reliable information pertaining to patents.

Ten 16 in. Engine Lathes, ten 18 in. Eng. Lathes, ten 14 in. Eng. Lathes, ten 15 in. Engine Lathes. Nicholson & Waterman, Providence, R. I.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker st., Philadelphia, Pa.

Quints' Pat. Auto. Steam Engine Governor. Correspondence solicited from mfrs. of Throttle Gov'nr Engines. Leonard & McCoy, 118 Liberty st., N. Y.

Curtis Pressure Regulators. Curtis Return Trap. Curtis Damper Regulator. See Nov. 5, p 15. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

Machinists' supplies, brass goods, m'f'rs' supplies, polishing materials, all kinds wire, metals, etc.; in any quantity. Jordan & Gottfried, 208 Canal st., N.Y.

For Best Return Steam Traps, Pressure Regulators, Positive-Acting Pump Govs., Back-Pressure Valves. T. Kieley, 11 W. 13th st., N.Y. Send for des'n.

The Brown & Sharpe Mfg. Co. have placed at No. 23 S. Canal st., Chicago, Ill., a sample line of milling machines and other machinery with S. A. Smith.

The Holly Manufacturing Company, of Lockport, N. Y., will send, on application, their pamphlet, illustrating pumping machinery and reports of duty trials.

W. H. Hoffman, consulting engineer, 94 Liberty st., N. Y. Mechanical engineering in all its branches; working drawings for the transmission of power by steam, water, air and electricity.

Hot Water Supply. A practical treatise on the fitting of hot-water apparatus for domestic and general purposes. By F. Dye. 82 pages, with 25 illustrations. 12mo., cloth, $1. Send for catalogue. E. & F. N. Spon, 35 Murray st., N. Y.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines, and current practice in testing engines and boilers. Price, $2, postpaid. Published by John Wiley & Sons, 15 Astor Place, New York.

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, the full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G CO., 96 Fulton st., New York.

MANUFACTURES

The Decatur (Ala.) Car Wheel and Car Spring Company are building shops.

The Linn Foundry, Birmingham, Ala., recently burned, will be rebuilt at once.

The Ellicott Machine Company contemplate enlarging their works at Baltimore, Md.

The old mill of the Exeter (N. H.) Manufacturing Company was recently destroyed by fire.

The agricultural works of W. E. Whitman, at Winthrop, Maine, were recently burned.

Heywood Bros. & Co. are making extensive additions to their chair factory at Gardner, Mass.

T. Murphy, Jacksonville, Fla., has begun work on the extension to his machine shop and foundry.

The Birmingham Flooring Company will largely increase the capacity of its plant at Avondale, Ala.

John Holiday, Milledgeville, Ga., is securing capital with which to build a foundry and machine shop.

The Board of Trade of Leavenworth, Kan., are prepared to offer for the citizens, special inducements for the location of small industries.

The Stewart Manufacturing Company have begun work on their shops at Chattanooga, Tenn. They will manufacture electrical and gas supplies.

The Milam County (Texas) Co-operative Cotton and Mercantile Alliance has been chartered by the State. Their headquarters will be at Cameron.

Weatherford, Tex., will have a system of waterworks in operation in a short time. Several citizens have organized a company for that purpose and have obtained a charter.

W. P. Davis, North Bloomfield, N. Y., manufacturer of drills and slotters, writes us: The present year's business is, we think, so far our best year, and think there is a gradual improvement in business.

T. P. Farmer, formerly of Boston, inventor of the Farmer lathe drill, has located in New York to engage in the practice of mechanical engineering, designing special tools, etc. He is located at 206 W. 23d street.

The Hoppes Manufacturing Company, Springfield, Ohio, write us that their trade in feed-water heaters and purifiers is very satisfactory. Recent shipments have been seven heaters, aggregating nearly 2,000 horse-power.

The Merrill-Stevens boiler and machine works, Jacksonville, Fla., previously referred to, are now being built. The capital stock of the company is $50,000. The shops will be 50 x 200 feet, and the company will build a dock 150 feet long.

The Castle Automatic Engine Works, Indianapolis, Ind., report being quite busy on engines and boilers. This company is bringing out a double cylinder engine for stationary and marine purposes, which will soon be ready for the market.

Work on the Linn foundry building, which was totally destroyed by fire a short time since, is progressing rapidly. The foundations have been laid and the frame superstructure begun. The building will be of wood built upon the plan of the old one. —*Birmingham* (Ala.) *Herald.*

The Hendey Machine Company, Torrington, Conn., write us: "We have lately put in and started an incandescent electric plant in our works, capacity 200 lights. We think the light as near perfect as it can be, and consider it one of the best investments we could make."

The Grand Rapids *Telegram-Herald* says: The Hitchcock Manufacturing Company, Cortlandt, N. Y., is talking with Lansing (Mich.) people about establishing a $200,000 plant in that city. If $15,000 bonus is raised they will come and agree to turn out 10,000 cutters and 5,000 buggies annually.

Lodge, Davis & Co., of Cincinnati, Ohio, write us that they are now placing on the market 17″, 24″ and 27″ engine lathes of the same design and construction as their 19″ and 21″ lathes. They will produce them in large lots. The 24″ x 10′ weighs 5,300 pounds and 27″ x 10′ weighs 6,500 pounds.

The Johnson Steel Street Rail Company have decided to locate their new works on the Von Lunen farm, close to Johnstown, Pa., where they have 190 acres of land. They will erect furnaces and rolling mills in addition to their present works at Woolvale. The company will at once lay a railroad track from the new location to Johnstown.

B. C. Davis, of this city, has made two very ingenious and expensive machines for making chisel-pointed blind staples. They produce a better class of staples than any heretofore made. Their capacity is 800 per minute or 480,000 in ten hours, which is enough staples to wire 4,000 pairs of common-sized blinds.—*Rome* (N. Y.) *Sentinel.*

A blanket mill, the first on the African continent, has just been opened at Cape Town, worked by Caffir girls, who receive twenty-four cents a day. The report of the Kaiping colliery in North China, made by Kwong Yung Wang, gives twenty cents as the daily pay of engine men, fifteen cents for miners and thirteen cents for door and switch boys. The cotton and jute mills of Bombay pay their operatives from ten to twelve cents a day.

At a special meeting of the stockholders of the Wainwright Manufacturing Company, of Boston, held on Oct. 26, the following officers were elected: Jere. Abbott, president; John A. Loring, vice-president; Percival L. Everett, treasurer; C. D. Wainwright, general manager; Jas. M. Betton, secretary. Directors: Jere. Abbott, John A. Loring, Percival L. Everett, Chas. S. Dana, Gideon Scull, Wm. B. Bacon and C. D. Wainwright. We are informed that the company is doing a good business, and has a long list of unfilled orders on hand.

Randolph & Clowes, proprietors of the Brown & Bros. tubing and boiler works of Waterbury, Conn., have just completed probably the largest projectile of its character ever made. It is a seamless drawn brass shell, 6 feet 8 inches long, of 14 inches inside diameter and 3-16 of an inch thick, and weighs completed 200 pounds. This shell with its conical head is all of one piece, being forced into shape by one of the heavy hydraulic rams used by this concern in the manufacture of seamless brass and copper tubing. The shell is intended for the new Zalinski gun now in process of construction.

A Chattanooga dispatch says: A wealthy Pennsylvania syndicate, represented by Charles Dougherty, member of Congress from the first district of Florida, has been quietly purchasing magnetic iron ore lands in Walker county, Ga., twelve miles from Chattanooga, and it has just leaked out this evening that they have already secured 20,000 acres and have options on several thousand more. A railroad will be built at Chattanooga, two furnaces erected and the property thoroughly developed. Experts have tested the magnetic ore, and it is superior to the ore of the Lake Superior region used for making Bessemer steel. There is great excitement in Walker county and land has advanced in price five-fold.

The Burden Iron Company has broken ground for the erection of a large building near the horseshoe warehouse at the steam mill, to be devoted entirely to the manufacture of horse and mule shoes and shoes of a special pattern. The building is to be of brick and will be about 300 feet long and 60 feet wide, one story in height and will have an iron roof. This building is intended to increase the facilities the company already has for the manufacture of their justly celebrated horseshoes, and when it is completed and the machines for manufacturing are placed in it the number of employes will of course be considerably increased. The foundation of the building will be of concrete, and the laying of the same will be commenced next week. The work is being done under the supervision of men in the employ of the company, and when finished will be a valuable addition to the manufacturing interests of the city—Troy, N. Y., *Evening Standard.*

Trials have been made at Havre with an electric launch built to the order of the French Government by the Forges et Chantiers de la Mediterranée. The vessel, which has rather full lines, measures 28 feet between perpendiculars and 9 feet beam, and is 5 tons register. The electromotor is the invention of Captain Krebs, who is already well known on account of his experiments in connection with navigable balloons, and of M. de Zédé, naval architect. The propeller shaft is not directly coupled with the spindle of the motor, but is geared to it by spur wheels in the ratio of 1 to 3, in order to allow of the employment of a light high speed motor. The latter makes 850 revolutions per minute, and develops 12 horse-power when driving the screw at 280 revolutions Current is supplied by a new type of accumulators made by Messrs. Commelin & Desmazures. One hundred and thirty-two of these accumulators are fitted in the bottom of the boat, the total weight being about 2 tons In ordering this boat the French Government stipulated a speed of 6 knots to be maintained during three hours with an expenditure of 10 horse-power. The result of the trials gave a speed of 6⅛ knots during five hours with 12 horse-power, and sufficient charge was left in the accumulators to allow the boat to travel on the following day for four hours. This performance is exceedingly good, since it shows that 1 horse-power hour has been obtained with less than 60 pounds of total weight of battery.—*Industries.*

Machinists' Supplies and Iron.

NEW YORK, NOV. 10, 1887.

Iron—American Pig—Since our last issue no important change has taken place in the condition of the market or the general aspect of trade. Dealers complain of the restricted demand, and consumers seem inclined to buy only to supply present wants, preferring to use up their supplies more closely and await the course of events, which seems in the direction of lower prices. Standard Foundry grades are still relatively firmer than others. We quote Standard Lehigh brands of No. 1 X Foundry $21 to $21.50. No. 2 X Foundry is easily obtainable at $19 to $19.50, and some brands at $18.50, and Grey Forge is in plentiful supply at $16.50 to $17.25.

Scotch Pig—The market has ruled quiet and steady. We quote Coltness $21.50 to $21.75; Glengarnock, $20 to $20.50; Gartsherrie, $21 to $21.50; Summerlee, $21.25 to $21.50; Eglinton, $19.50; Langloan, $20.50 to $21; Dalmellington, $19.75 to $20, and Clyde $19.75 to $20.

Antimony—Regulus has been moderately active in a jobbing way, with values ruling steady. We quote Hallett's brand 8¾ cents, and Cookson's, 9c.

Copper—The trading here has been heavy, over 3,200,000 pounds having changed hands during Saturday and Monday at 12¾c. down to 12.35c. for spot; 12¾ to 12¾ for November.

Spelter—The market for Western is without change, a few car lots of Western comprising the only business reported, and prices remaining 4½ cents for ordinary brands; 4.60c. for prime, and 4.70 to 4.75 for choice. We quote Domestic 4.50 to 4.70 cents; Refined, 5¾ to 6 cents, and Silesian 4.95 to 5 cents.

Tin—The jobbing demand has been moderate, dealers asking 32½c. cash and 32¾c. thirty days.

We quote jobbing lots, Straits and Malacca, 32½c. cash, 32¾c. thirty days.

✲WANTED✲

"Situation and Help" Advertisements only inserted under this head. Rate, 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Wanted—An engagement as inspector of work for the construction of new locomotives. T. R. H., Paterson, N. J.

A first-class draftsman and designer with 17 years practical and technical experience wants situation. Address T. S., AM. MACHINIST.

Mechanical draftsman, 7 years' experience in locomotives, machine tools, hoists and jobbing, desires situation. B. W., care AM. MACHINIST.

A young man 23, with theoretical mechanical knowledge, wishes to learn the machinist trade; will serve an apprenticeship. Pinion, AM. MACHINIST.

Wanted - a blacksmith, experienced in drop and machine forging, to take charge. Address, stating experience and wages expected, Foreman, Box 64, AM. MACHINIST.

A mechanical draftsman of 25 years' experience in general and special machine design, desires a position; can give best of references. Address BOX 71, AM. MACHINIST.

Wanted—Two first-class patternmakers at once; prefer those that are accustomed to power transmission of all kinds with the exception of gearing. The Falls Rivet Co., Cuyahoga Falls, O.

Draftsman wanted. Must have had practical experience in machine design. Address, stating age, experience, reference, and compensation wanted, The Yale & Towne Mfg. Co., Stamford, Ct.

Wanted—Position as superintendent or foreman by a young man who has held the same for a number of years on fine tools, interchangeable work and automatic machinery. Best of references. W. H. S., 1331 So. 16th st., Phila., Pa.

A good draftsman and machinist, used to handling men, and familiar with heavy engine and mill work, now superintendent of large works in above line, wishes to change where ablity will command reasonable remuneration. Earnest, AM. MACHINST.

A well educated, practical machinist, well posted on toolmaking and special machinery for manufacturing, would like an engagement with a good, driving party. Now and for years past in charge of a shop with 50 men. Well acquainted with the economical management of a shop, and the inventor and builder of much original machinery now in successful operation. Address "Cutter," AM. MACHINIST.

Wanted—Several competent salesmen for a steam mechanical apparatus of merit proved by 10 years' use; permanent positions. Only those competent to earn large income on commission need apply. Reference and personal particulars required before notice. Address "Cansell," AM. MACHINIST.

✢ MISCELLANEOUS WANTS. ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Crescent Boiler Tube Expander; second to none; price in reach of all. Crescent Mfg. Co., Cleveland, O.

The Crescent Link Belt Coupling; something new; sample free. Crescent Mfg. Co., Cleveland, O.

Stationary and boat engines, boilers; best made, cheapest price. Washburn Engine Co., Medina, O.

Special tools and machines for mfg. designed and built to order; mechanical and Patent Office drawings. I. A. Weston & Co., Syracuse, N. Y.

A. C. Christensen, 26 Church st., N. Y., mech. and hydraulic engineer, late chf. draftsman at H. R. Worthington. Designs and working drawings of water works, pumps, gen. mach. & pat drawings.

Patent rights of compensating car wheel for sale (subject of illustration in AMERICAN MACHINIST, Oct. 15). Principals only treated with. Address Frederick Myers, 211 Webster st., East Boston, Mass.

For Sale—One horizontal two flue boiler; diameter of flues, 15 inches; diameter of boiler, 48 inches; length of boiler, 28 feet. In good condition. Apply to The Fahy's Watch Case Co., Sag Harbor, Long Island, N. Y.

BRADLEY'S UPRIGHT CUSHIONED HELVE HAMMER

Established 1832.

Combines all the best elements essential in a first-class Hammer. Has more good points, does more and better work and costs less for repairs than any other **Hammer** in the **World.**

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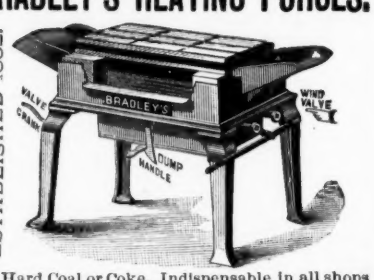

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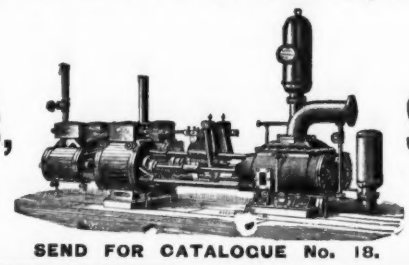

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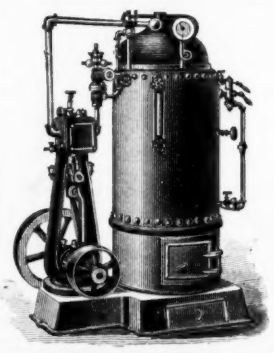

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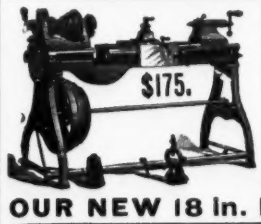

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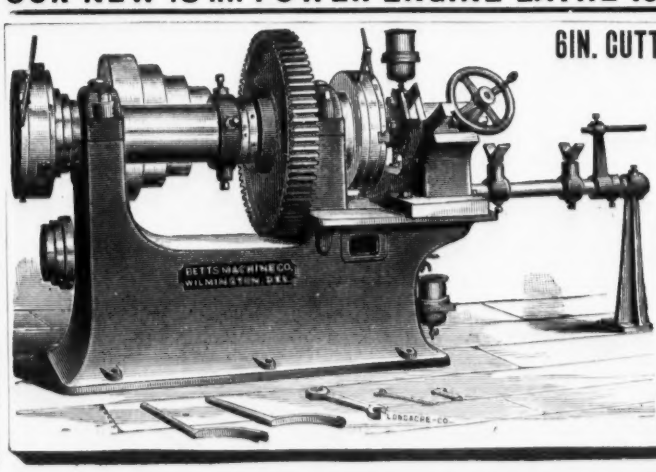

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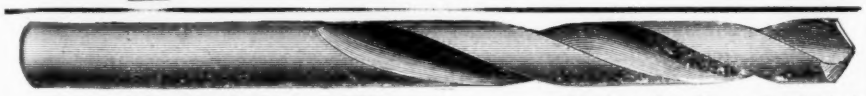

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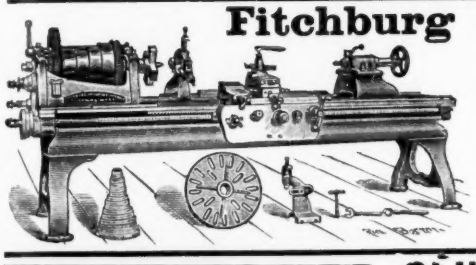

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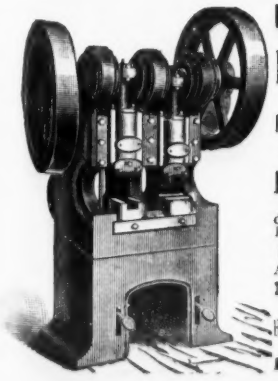

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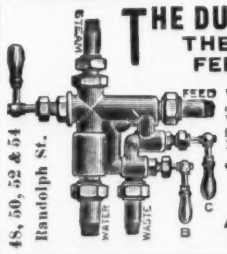

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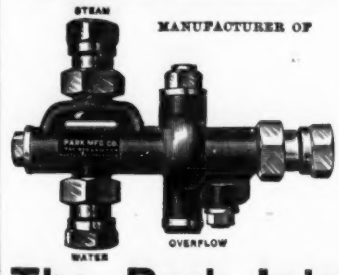

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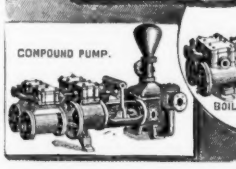

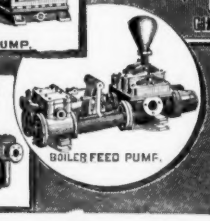

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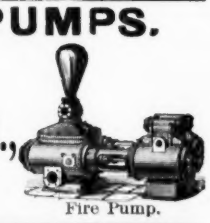
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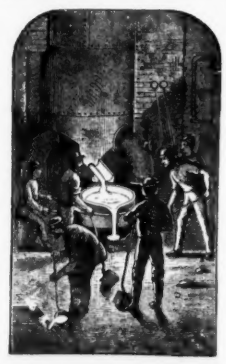

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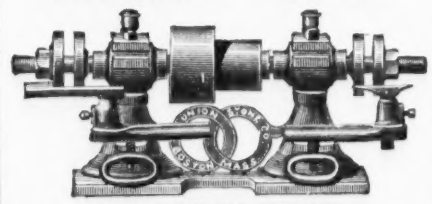

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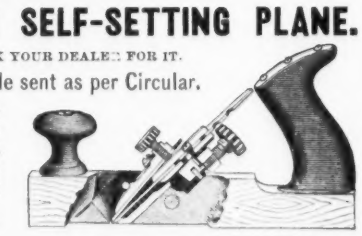

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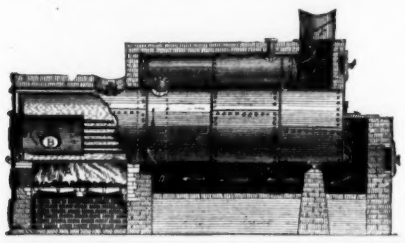

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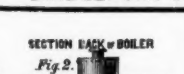

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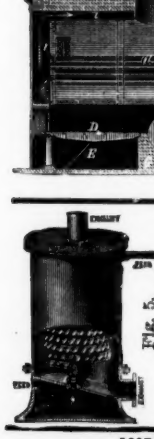

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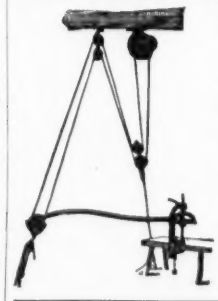

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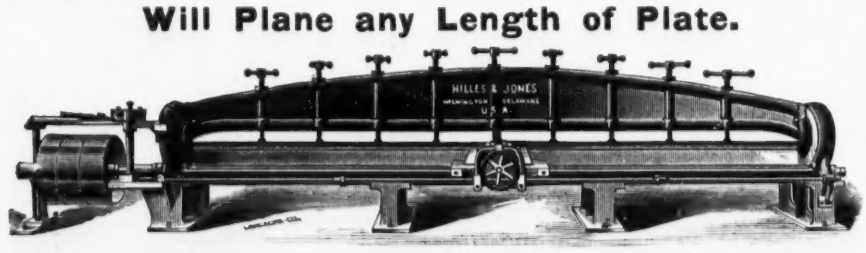

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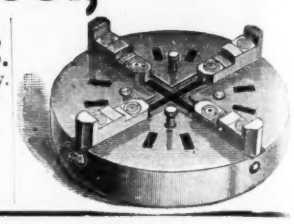

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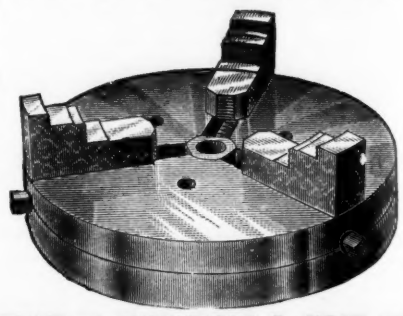

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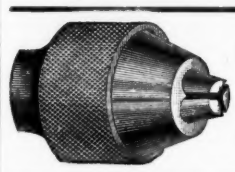

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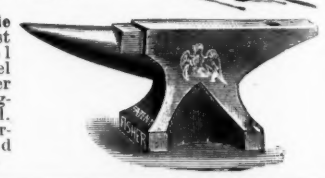

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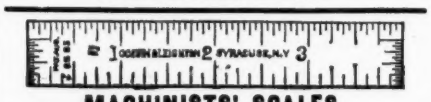

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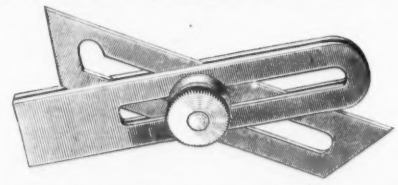

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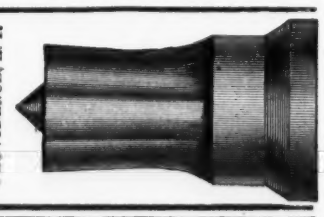

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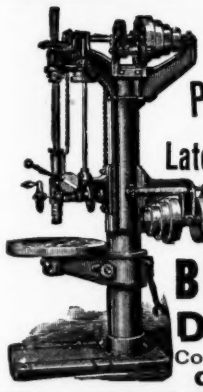

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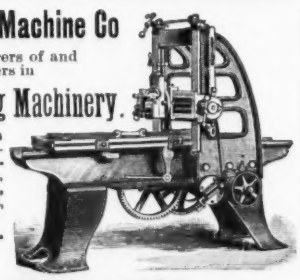

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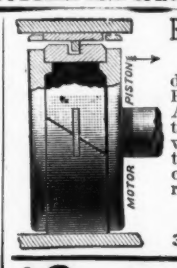

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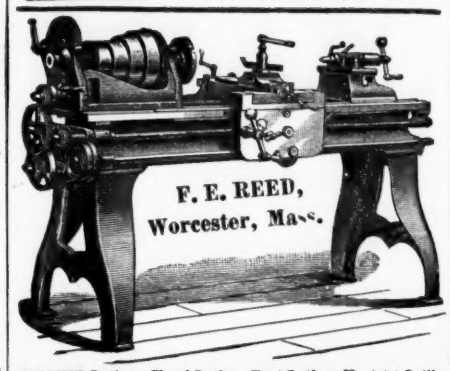

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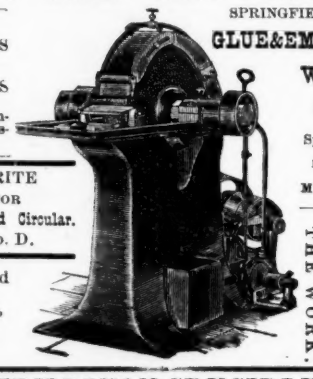

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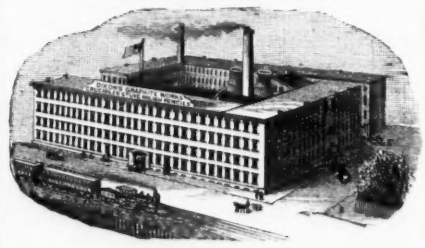

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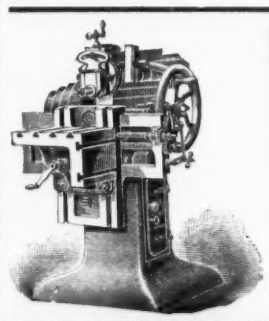

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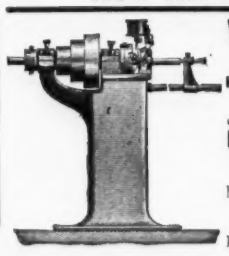

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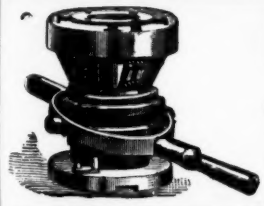

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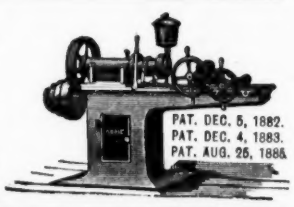

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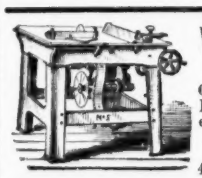

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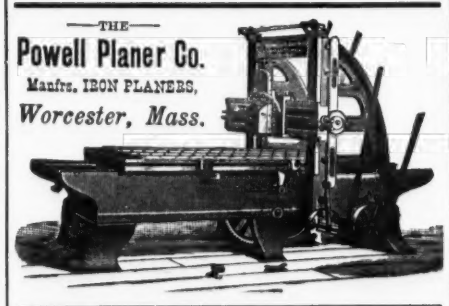

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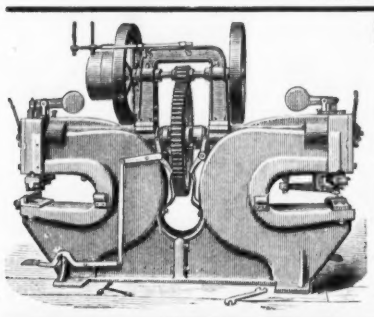

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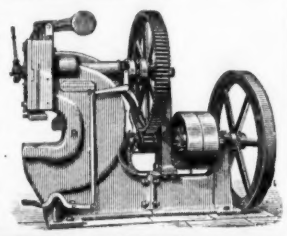

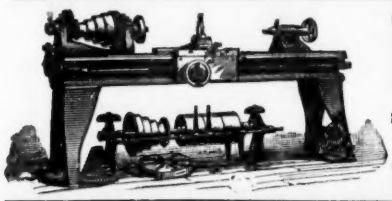

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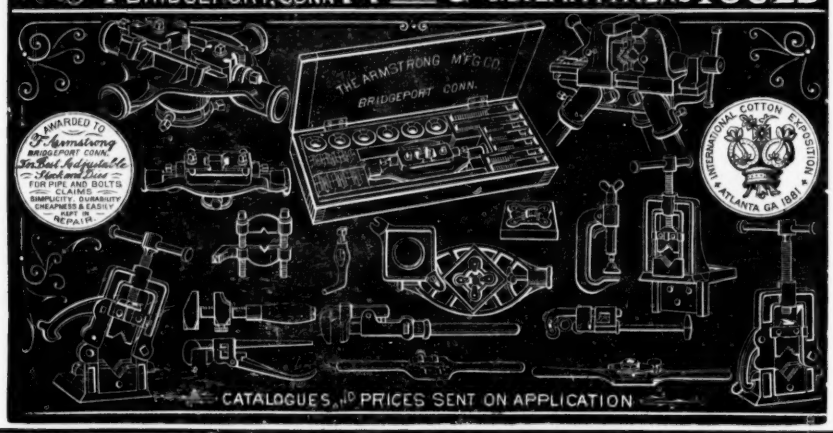

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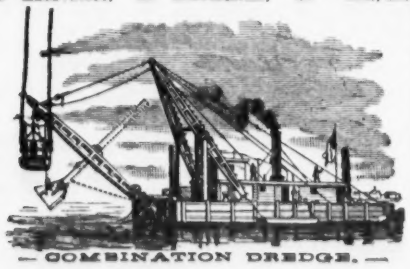

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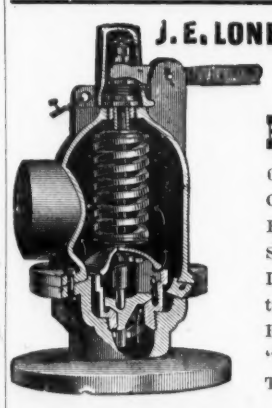

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Manufacturers of
PATENT OILERS,

Cylinder Sight Feed Cups, Government Regulation Pop Safety Valves, for Locomotive, Stationary and Marine Boilers, also the "Reliable" Steam Trap.

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One 32" x 20' second hand, a bargain.
One 36" x 16' triple geared, very heavy, new.
One 32" x 18' " " " " "
One 42" x 18' " " " " "

THE ABOVE ARE FOR SALE AT VERY LOW PRICES.

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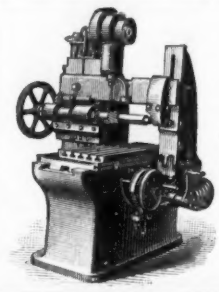

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METAL-WORKING MACHINE TOOLS

FOR

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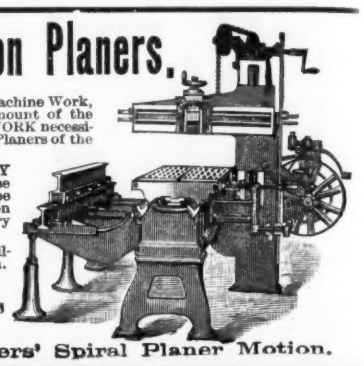
The Open Side Iron Planers.

Adapted for all classes of Machine Work, and especially for a large amount of the EXTRA WIDE and HEAVY WORK necessitating the Large and Costly Planers of the regular style.

The QUALITY and QUANTITY of work performed on these Planers is GUARANTEED to be UNEXCELLED by that done on the modern tools of the very best makes

Prices, phototypes and detailed information on application.



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These tools are driven by the Sellers' Spiral Planer Motion.

STEEL CASTINGS

From 1-4 TO 15,000 lbs. WEIGHT.

True to Pattern, sound, solid, free from blow-holes and of unequaled strength.
Stronger and more durable than iron forgings in any position or for any service whatever.
40,000 CRANK SHAFTS and 30,000 GEAR WHEELS of this steel now running prove this.
Cross-Heads, Rockers, Piston-Heads, etc., for Locomotives.
STEEL CASTINGS of every description.
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CHESTER STEEL CASTINGS CO.,
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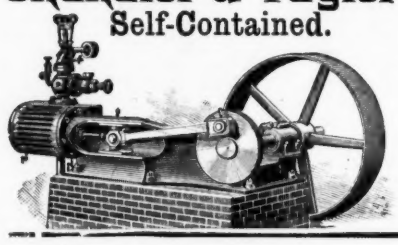
Chandler & Taylor's STEAM ENGINES

Self-Contained.



Are Strong, Well-Built and Serviceable.
Are designed for Heavy and Continuous Work.
May be run at High Speed when desired, performing the duties of High Grade Engines,
And are sold at the prices of ordinary Engines.

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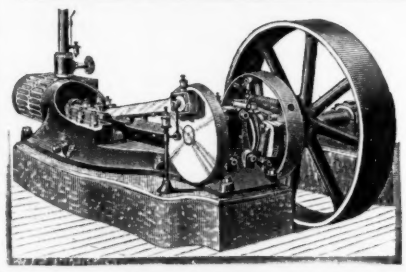

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BUILDERS OF
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BOILERS, ETC.
Complete Power Plants Furnished and Erected.

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PORTER-HAMILTON ENGINE.

FOR HEAVY WORK & LARGE POWERS. EXTRA HEAVY DESIGN.
Send for Catalogue.

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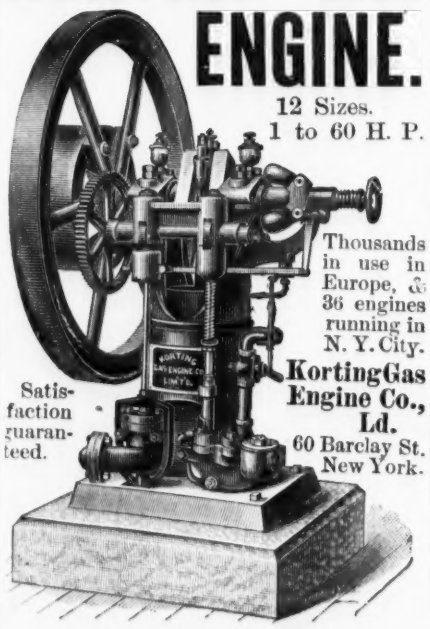
12 Sizes.
1 to 60 H. P.



Thousands in use in Europe, & 36 engines running in N. Y. City.

Satisfaction guaranteed.

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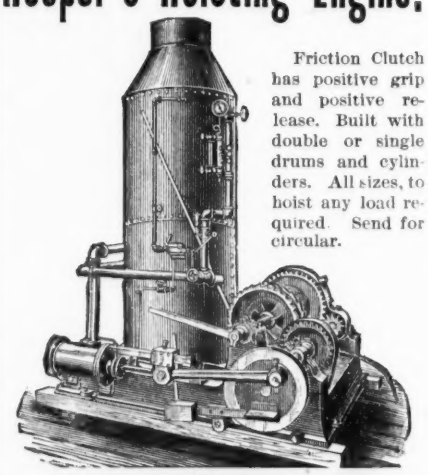

Friction Clutch has positive grip and positive release. Built with double or single drums and cylinders. All sizes, to hoist any load required. Send for circular.

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East Ferry Street Iron Works
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BARGAIN LIST.

		Second Hand.
One 70 H. P. Stationary Boiler		" "
" 60 H. P. " "		" "
" 50 H. P " "		" "
Two 40 H. P. " "		" "
One 30 H. P. Vertical "		" "
Two 15 H. P. " "		" "
One 40 H. P. Portable Engine		" "
" 30 H. P. " "		" "
" 8 H. P. " "		" "
" 60 H. P. Stationary "		" "
" 20 H. P. " "		" "
" 20 H. P. Vertical "		" "
Two 12 H. P. " "		" "
One Surface Planer, 27" wide,		" "
" Resawing Machine,		" "
" Circular Saw Mill, 52" Saw,		" "

New and Second Hand Shafting, Hangers, Pulleys and Belting.

S. L. HOLT & CO.,
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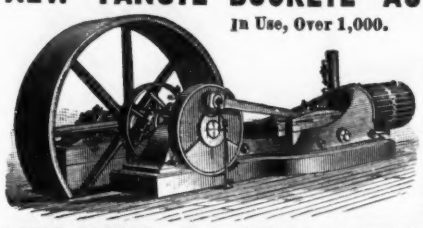
NEW TANGYE BUCKEYE AUTOMATIC CUT-OFF ENGINES.

In Use, Over 1,000. 25 to 1,000 H. P.



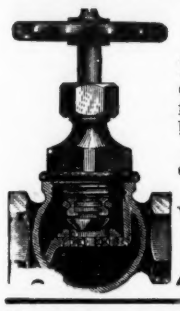
These engines are the combined result of long experience with automatic cut-off regulation, and most careful revision of all details. They are designed and constructed for heavy and continuous duty at medium or high rotative speeds Highest attainable Economy in Steam Consumption and superior regulation guaranteed. Self-contained Automatic Cut-off Engines 12 to 100 H P for driving Dynamo Machines *a specialty* Illustrated Circulars, with various data as to practical Steam Engine construction and performance. free by mail. Address, BUCKEYE ENGINE CO., Salem, Ohio.

SALES AGENTS: W. L. SIMPSON, 301 TELEPHONE BUILDING, 18 CORTLANDT STREET, N. Y. { N. W. ROBINSON, cor. Clinton & Jackson Sts., Chicago, Ill. ROBINSON & CARY, St. Paul, Minn.

KENSINGTON ENGINE WORKS, LIMITED, PHILADELPHIA.

Sole Licensees and Manufacturers for New Jersey (South of Trenton), Eastern Pennsylvania, Delaware, Maryland and Virginia.

BLESSING'S RENEWABLE-SEAT GLOBE, STRAIGHTWAY and CHECK VALVES.



The renewable Seats and Disks are cast from the best Phosphor Bronze Metal, which has lasting qualities, double that of the best Steam Metal commonly used in first-class valves. The Seats are simply screwed to place by the use of a special wrench furnished with each valve.

These valves are equally applicable to steam, water, or other fluid pressure.

We also manufacture **Blessing's Albany Steam Traps, Water Circulator and Purifier; and Pump Governor.**

SEND FOR CIRCULAR.

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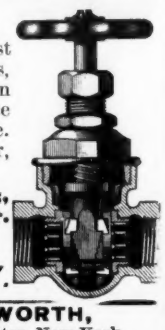

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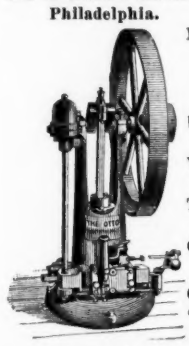

HORIZONTAL "Otto" Gas Engines.
VERTICAL "Otto" Gas Engines.
TWIN CYLINDER "Otto" Gas Engines.
COMBINED "Otto" Gas Engines and Pumps.
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Consume 25 to 75 Per Cent. Less Gas than ANY other Gas Engine doing the same work.

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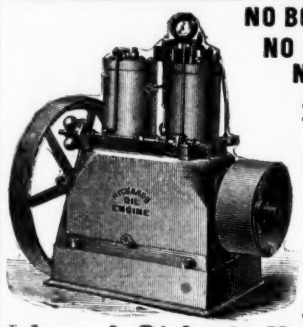
Indicating Engineer and Mechanical Draftsman
Correspondence solicited.



NO BOILER. NO STEAM. NO DANGER.

FUEL, CRUDE PETROLEUM OR KEROSENE.

Started instantly with a match.

Cheaper than all others.

Adams & Richards Machine Co.,

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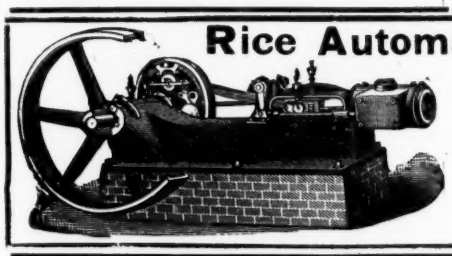
Rice Automatic Cut-off Engine



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Balanced Valve. High Speeds.
Stationary Oilers. Best Economy.

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THE SKINNER ENGINE CO.

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PORTABLE AND STATIONARY
ENGINES and BOILERS
Send for Catalogue and Prices.

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New and Second-hand, on Hand.

12 in. x 6 ft.	Engine Lathe,		new.
13 in. x 6 ft.	"	Ames,	"
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16 in. x 6-8-10 & 12 ft.	"	Bridgeport,	new.
16 in. x 6	"	Blaisdell,	"
18 in. x 8 ft.	"	Blaisdell,	"
19 in. x 14 ft.	"	Pond,	nearly new.
20 in. x 10 & 12 ft.	"	Ames,	new.
24 in. x 10 14 & 20 ft.	"	Ames,	"
23 in. x 12 & 14 1-2 ft.	"	Bridgeport,	"
24 in. x 16 ft.	"	New Haven,	good order.
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26 in. x 7 ft.	"	Brettell,	new.
30 in. x 7 ft	"	New Haven,	fair.
30 in. x 8 ft.	"	Hewes & Phillips,	new.
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12 in. Shaper,		Traveling Head,	new.
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16 18 20-23-25-28-34 in. Drills.		30 in. Radial Drill.	
13 in Stroke Slotter		H. & P.	new.
Center Bolt Cutter,			new.
5 in Cutting Off Machine.			Star.
Merrill Drops, 800 lbs.			good order.
Bement 2250 lb. Steam Hammer.			

Milling Machines. Screw Machines, Slate Sensitive Drills. Gang Drills, and full line of all kinds of Machine Tools. Send for list and specify what is wanted.

E. P. BULLARD,

72 Warren Street and 62 College Place, New York.

IMPORTANT!

We are now placing on the market 17", 24", and 27" Engine Lathes, same design and construction as our celebrated 19" and 21" Lathes.

We shall produce them in large lots, in order that we may be able to offer them at the popular prices that induced the unprecedented sale of our 19" and 21" Lathes.

Weight of 24" with 10 ft. bed, 5200 lbs.

Weight of 27" with 10 ft. bed, 6500 lbs.

We furnish, without extra charge, *Taper Attachment, Compound Rest, Automatic Stop for Carriage, Pulley Rest, Etc.*, in addition to regular attachments.

WRITE FOR PRICES, WITH CUTS AND DESCRIPTIONS.

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Machine Tools,

159, 161, 163 and 165 EGGLESTON AVE.,
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CINCINNATI, OHIO.

(See our advertisement on last page.)

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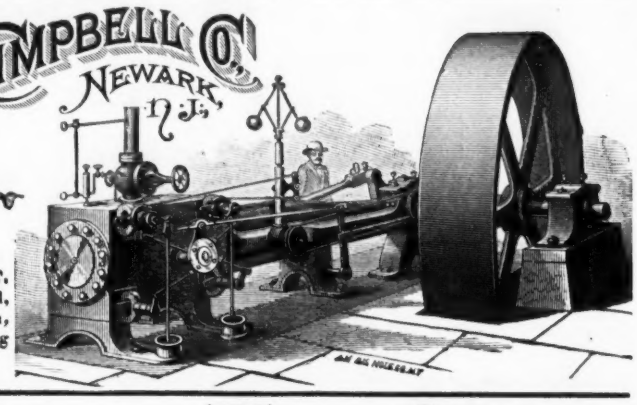
MANUFACTURERS OF IMPROVED CORLISS STEAM ENGINES IN FULL VARIETY



Sizes Varying from 30 to 2000 Horse Power.

Horizontal or Vertical, Direct Acting or Beam, Condensing, Non-Condensing or Compound.

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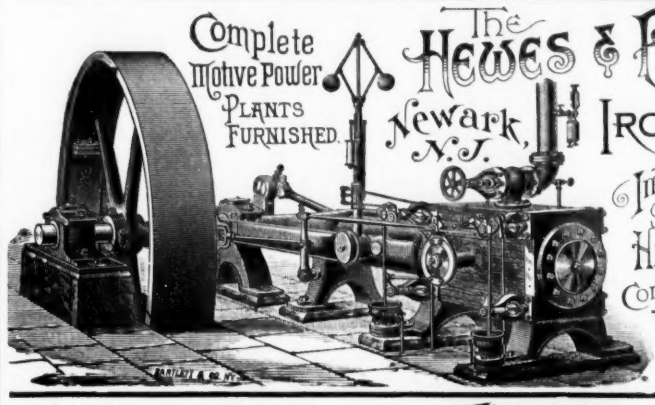

Improved CORLISS ENGINES, High Pressure. Condensing and Compound TUBULAR BOILERS.

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THE IMPROVED FISHKILL CORLISS ENGINE

BUILT BY THE FISHKILL LANDING MACHINE CO.,

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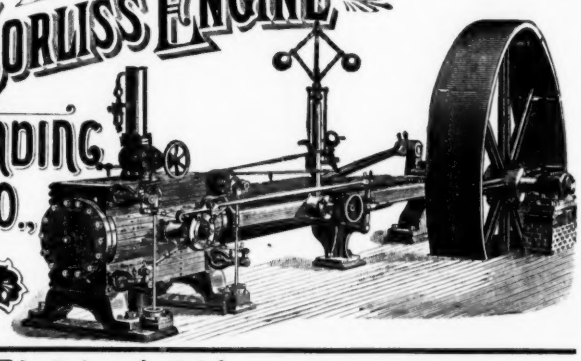

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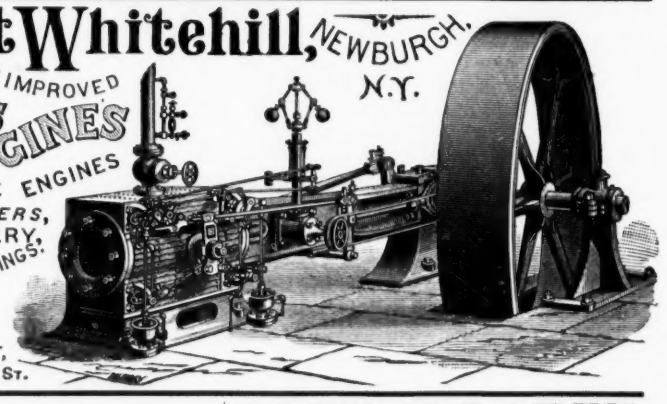

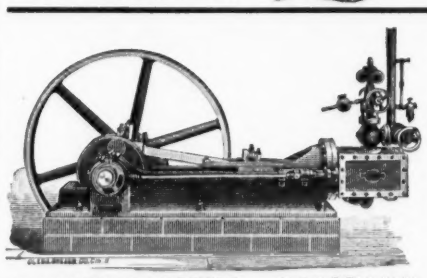

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ENGINES from 15 to 400 Horse Power.

Boilers of Steel and Iron supplied to the trade or the user. Send for Catalogues.

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Works at ERIE, PA.

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Having enlarged our Foundry and otherwise added to our facilities, we are prepared to execute orders for castings weighing from a few pounds to *forty tons*. Our Boring and Turning Mill is one of the largest in the United States, by which we can bore and turn a wheel or cylinder up to 30 feet in diameter, and we can plane 30 feet long by almost any width. With our *unsurpassed* means for handling heavy work, and shipping *by boat or rail*, we are enabled to

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to customers.

We make a specialty of machinery for making Sugar, and furnish everything necessary to fully equip Sugar Refineries or Plantations. Satisfaction guaranteed, and patronage solicited.

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"Glenwood Station," Yonkers, N. Y.

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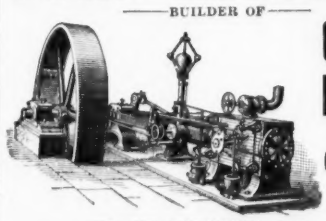

CORLISS Engines, AIR Compressors and BOILERS.

HOBOKEN, N. J.

Machine Tools

ON HAND.

A Large Stock of Regular Sizes ready for

Immediate Delivery

Inquiries for Prices solicited.

HILL, CLARKE & CO.,

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Manufacturers of

MACHINERY AND TOOLS,

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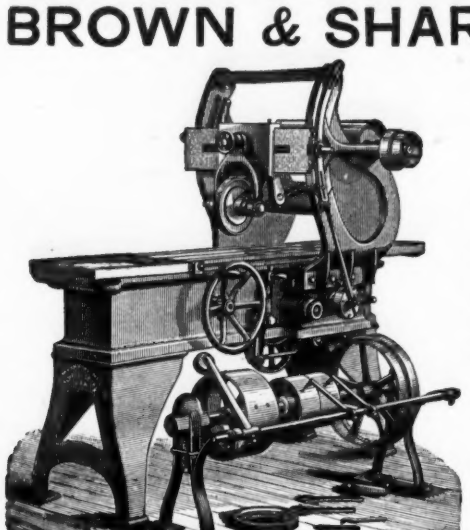

No. 3 SURFACE GRINDING MACHINE.

This Machine is designed for flat and true surface grinding and finishing. It is an effective substitute for the operations of filing and stoning. The entire cost of files, and three-quarters of the labor usually expended on these operations are saved, beside obtaining better surfaces upon the work done. For all finished parts of machinery of cast iron or steel, hard or soft, for punches or dies, straight edges, flattening dies, etc , it will prove invaluable, and will produce fine work with little expense.

It will Grind 14″ wide, 36″ long, 10″ high, using a 9″ wheel.

The countershaft has tight and loose pulleys 8″ diam., 4″ face, and should run about 276 turns per minute.

Price includes countershaft, wrenches, etc., all complete, delivered F. O. B. at Providence, R. I. Weight, 2,500 lbs.

We are prepared to furnish this machine lengthened, to grind 5 ft. long. Weight, 3,000 lbs.

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NILES TOOL WORKS, HAMILTON, OHIO.

Lathes, Planers, Shapers, Slotters, Etc.

HAND POWER

Traveling Crane

—FOR FOUNDRY USE.—

FOUNDRY TRAVELER.

Particulars on application. Full Specifications and Tender promptly submitted on receipt of capacity and span of bridge desired.

SOLE MAKERS,

THE YALE & TOWNE MFG. CO.

Catalogues on application.

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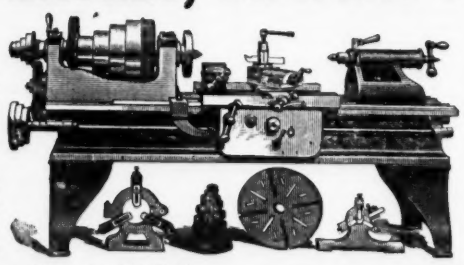
ENGINE LATHES, SHAPERS & DRILLS.

20-INCH LEVER DRILL.



20 in. Upright Drill.
24 " " "
26 " Back Geared and
30 " " Power Feed
38 " Drills.

26-INCH BACK GEARED AND POWER FEED DRILL.

LODGE, DAVIS & CO.

CINCINNATI, OHIO.

Send For Prices. It Will Pay You.

(See important notice of Engine Lathes on page 15.)

E. GOULD & EBERHARDT

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Eberhardt's Patent

AUTOMATIC GEAR CUTTER.

18 in. 25 in. 36 in. 50 in. 60 in. 84 in. Sizes.

"Experts pronounced it the best."

E. E. GARVIN & CO.,

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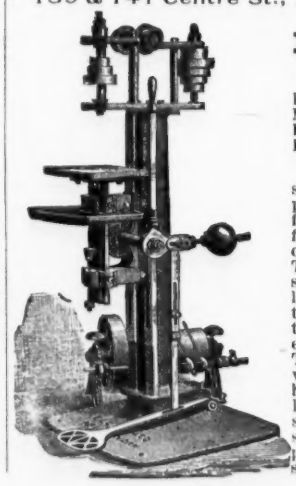
Manufacturers of

Machinists' Tools,

Including Milling Machines, Drill Presses, Hand Lathes, &c.



The machine shown in cut is especially designed for jobbing, and is fitted up with one or two spindles. Those with two spindles have pulley, with two sections, which gives two speeds to each spindle. Those fitted up with one spindle have a cone pulley with three sizes. The back shaft has a cone pulley with four sizes.

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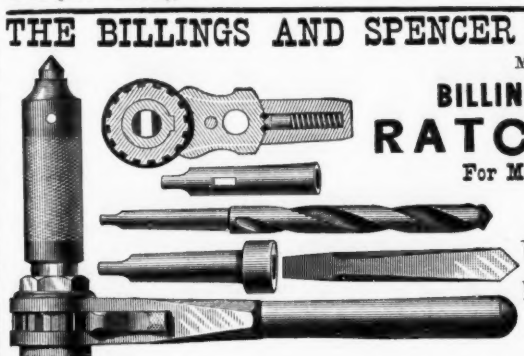
Manufacture Gardner & Woodbridge patent and new Threading Tool, Rhodes' Square Thread Tool, Woodbridge Lathe and Planer Tool, Johnson's Cutting-off Tool, Kidd's Improved Dividers and Adjustable Caliper Gauges.

THE BILLINGS AND SPENCER CO., HARTFORD, CT., U. S. A.



MANUFACTURERS OF

BILLINGS' DOUBLE-ACTING RATCHET DRILL

For Morse Taper Shank Drills.

Packer Ratchet Drills,

Packer Boiler Ratchet Drills,

Packer Auger Ratchet Drills,

DROP FORGINGS

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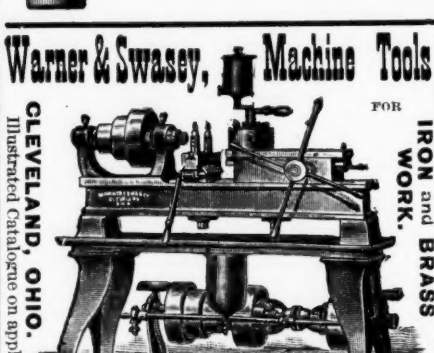

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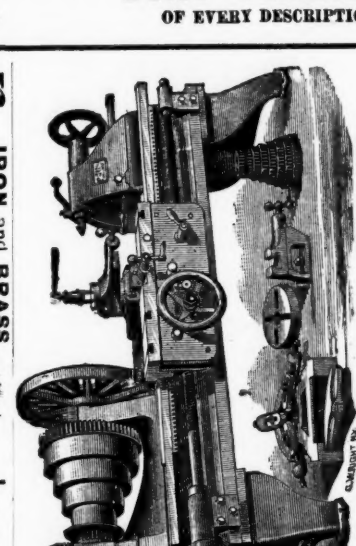

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